Robert L. Bates

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# ABOUT WRITING REPORTS, SOME TIPS FROM G. K. GILBERT

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ABSTRACT. Present day geologists may profit by following some of the practices of G. K. Gilbert in report writing. More complete preparation of maps while in the field, the writing of a first draft of descriptions and interpretations while still in the field, and the writing of a complete caption for each photograph at the time the picture is taken can make the task of final report writing less onerous.

Every year much good scientific data is lost and the efforts to procure it are wasted because individuals fail to write a report about their findings. This failure is widespread in the scientific world and not at all restricted to geology.

By now, probably, every possible excuse has been offered for failure to produce a report but the real reason, "I don't know how to organize my work," is seldom if ever admitted.

Most geologists feel that their college and graduate training were adequate for fact finding and for evaluation and interpretation of the facts, but few geologists speak enthusiastically about the training they received in writing reports. This deficiency in formal education, though, can be remedied by studying the methods of others who succeeded, like Gilbert, and by adapting to oneself the other person's method.

Although there is no pat remedy for getting reports written, some waste could be avoided if more geologists tried a method that G. K. Gilbert found both workable and helpful. Gilbert's methods are worth study for after all he was one of the great American geologists of all times, in the opinion of many he was the greatest.

Gilbert's situation differed in many ways from that of present day geologists. Many of the tools that are commonplace today were not available to him. But the principles behind fact finding, evaluating facts, and reporting on them have not changed.

Only a little of Gilbert's time was required for compiling maps. He had the full office season to work on his reports, along with the library studies, microscopy

* Publication authorized by the Director, U. S. Geological Survey.

or other laboratory work that are a necessary part of good research. Today, many geologists—too many it might be added—devote an excessive proportion of their office season to map compilation; too little time is left for writing reports. But a present day geologist can hardly expect to write as fully and thoughtfully as Gilbert did while giving less emphasis and devoting less time to that part of the job.

If we are to write as Gilbert did we need field methods that enable the present day geologist to return to the office with his field maps in such shape that little time is needed to make them ready for photographic reproduction and coloring. This was accomplished during the plane table era, but the coming of air photos has cut into the time available for report writing. Much time that should have gone to writing has been spent laboriously transferring lines from air photos to a map base. For a while geologists were transferring their lines to non-transparent bases like metal mounts. How inspiring can a dark room be?

The cure of course is not to do away with air photos or the various means for achieving scale true map compilations; rather, the geologist's task is to adapt these in the field in such a way that he still has as much office time as Gilbert had for writing.

But Gilbert was not content with only the office season for writing. He prepared what amounted to a draft of his manuscript *before he left the field*. Whole paragraphs of Gilbert's classic reports are verbatim from his field notebooks. To even consider taking time *in the field* to write manuscript will come as a shock to many, but the practice has many advantages.

In the first place, the draft, however preliminary, helps locate gaps in one's data. In manuscript form descriptive material becomes orderly and even though the writing is poor, the missing parts are discovered while they still can be obtained.

Secondly, a field draft of a manuscript helps in evaluating and analyzing the data while one still is in a position to make more critical observations if needed. Fuzzy thinking and ill-considered interpretations show more conspicuously on paper than when filed as mental notes or passing thoughts. Too, one is enabled to judge whether the available facts are adequate to support a conclusion that already has been reached. In today's world, scientists no less than engineers, tend towards the fault known as "over-design."

A third advantage is that most people can write most quickly and with most inspiration while the scene or outcrop is still before them. In proper environment the right words come easily. It takes a superior mind to write good geologic descriptions from memory, or from notes, even though the office is air-conditioned and the writer is repeatedly refreshed with coffee breaks. Under more favorable circumstances, as in the field, writing can be fun, and evidently it was for Gilbert.

Gilbert was fluent, and few can hope to write field drafts as intelligible and readable as his were. Nevertheless, it is helpful to have a field draft of a manuscript despite inadequacies in its organization, completeness, and expression. For example, the draft provides a basis for any summary reports that may be needed. The preparation of a summary report can be nearly as time consuming as prepara-

tion of a comprehensive one if the summation must be prepared before the data are organized in a form from which they can be summarized. Abstracts and summaries should be written after a manuscript is completed, not before, and not merely to save time but for the sake of quality too.

Further, the preparation of a summary report provides insurance against loss of the investment in the study, regardless of how further progress on it might be interrupted. The average field project is more costly than most homes and deserves equal insurance, the kind that insures the data always will be available in a form others can use. Gilbert's practice provided such insurance. No matter what interruptions were imposed on him, his data were in a form that made them available to his colleagues.

In the matter of illustrations, photography is a mixed blessing for geologists. Observation had to be critical when, as with Gilbert, the outcrop had to be sketched. His notebooks are replete with line drawings that illustrate what he saw, and each drawing is described as fully as he would describe it in his publication. Perhaps some of the advantages of Gilbert's method could be applied to photography by writing, as if for a manuscript, a complete caption of each photograph ***at the time it is taken.***

Gilbert's practices led to good reporting of the facts, which no doubt contributed to his outstanding evaluation and analysis of them. By keeping his thoughts organized and recorded on paper *as his research progressed* he found writing stimulating rather than a chore and very likely this was at least part of the secret of his success.

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## 1959 ANNUAL MEETING

The 1959 Annual Meeting of the National Association of Geology Teachers will be held at Ohio State University, Columbus, Ohio, on December 4-5. Meetings of the officers and various committees will take place in the evening of Friday, December 4th. The morning of Saturday, December 5th, will be devoted to the Annual Business Meeting and miscellaneous papers. Two symposia will be held during the afternoon, the first devoted to "The Teaching of Introductory Geology" and the second to "Honors Programs and Undergraduate Research." Especially invited speakers will lead these symposia with ample opportunity for discussion from the floor. The meetings will close Saturday evening with a banquet at which the Neil Miner Award will be presented and the retiring president will give his address. Anyone wishing to give a paper at the meetings will please send the title to Robert L. Nichols, Department of Geology, Tufts, University, Medford, Massachusetts on or before June 1, 1959.

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# RECENT DEVELOPMENTS IN PALEONTOLOGY

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ABSTRACT. Current major trends in paleontologic work include increased emphasis on paleoecology, critical reevaluation of the concepts of stratigraphic paleontology and revision of the systematics of fossil invertebrates. The *Treatise on Marine Ecology and Paleoecology*, the "Notes" and "Reports" of the American Stratigraphic Commission and the *Treatise on Invertebrate Paleontology* respectively present the more significant results of this work. Recent individual discoveries of interest to teachers are: (1) structurally preserved microfossils from the Huronian, (2) geochemical studies of organic compounds from the Precambrian, (3) Cambrian lycopsids (?), (4) the fruiting bodies of *Glossopteris* and *Gangamopteris*, (5) Triassic palm-like plants, (6) the extreme morphologic and ontongenetic variability of some living foraminifers, (7) a living representative of the Monoplacophora, and (8) silicified insects from the Miocene.

Paleontology is a large and diverse subject and even the most recent advances in all specialties cannot be adequately discussed in a short paper. Thus my approach will be to single out a few discoveries and developments of general interest. Also, I would like to call attention to the major current activities in the field.

The recent Treatise on Marine Ecology and Paleoecology (Hedgpath, 1957 and Ladd, 1957) summarizes a wealth of material on the subject and should become part of the working library of any teacher of paleontology, stratigraphy or historical geology. In the field of stratigraphic paleontology the American Commission on Stratigraphic Nomenclature has been engaged since 1947 in critical reevaluation of the basic concepts in stratigraphy, including both time-rock and biostratigraphic units. This work has led so far to the publication of nineteen "Notes" and five "Reports" (American Commission on Stratigraphic Nomenclature, 1947-1958) and is intended to culminate in a "stratigraphic code" for American stratigraphers or historical geologists. In addition to its formal publications the Commission's activities have stimulated many independent articles discussing various aspects of the proposed code. These papers have appeared in the Bulletin of the American Association of Petroleum Geologists and in other journals. As yet, however, no concensus regarding even the most basic concepts and units has been obtained, and stratigraphers generally are involved in vigorous, often acrimonious, debate. In the *interim*, Dunbar and Rodgers' (1957) discussion of stratigraphic synthesis, section IV of their textbook, may be taken as a rather objective appraisal of the major points of view.

Systematic paleontologists are already reaping the benefits of the collaboration of specialists the world over who are now preparing the Treatise on Invertebrate Paleontology under the guidance of a committee representing the Paleon-

* Contribution from the Museum of Paleontology, University of California, Berkeley, California.

tological Society, the Society of Economic Paleontologists and Mineralogists and the Paleontographical Society. Volumes (D) Protista 3 (radiolarians, tintinnines), (E) Archaeocyatha, Porifera, (F) Coelenterata, (G) Bryozoa, (L) Mollusca 4 (ammonoid cephalopods) and (P) Arthropoda 2 (chelicerates, pycnogonids) are already published and further additions during the next few years should provide English speaking paleontologists with their first comprehensive guide to invertebrate fossils since the publication of Eastman's translation of Zittel. Six out of eight volumes of a less well-known treatise, *Traite de Paleontolgie,* have also appeared during the last seven years and provide a ready reference in identifying fossil genera. This French work also includes fossil vertebrates.

Partially as a result of the need for a "Treatise classification," the basic higher taxonomy of the fossil invertebrates has been and is being thoroughly reexamined and revised. Details are beyond the scope of this discussion, but the recently current schemes, based in large part on application of Haeckel's biogenetic law are largely inadequate and require extensive revision to account for the accumulated observations of the last fifty years.

In addition to these major, group research efforts, I would also like to emphasize the current need for systematic paleontologists in educational and research institutions. During the 1957 national meetings of the Paleontological Society, G. A. Cooper devoted much of his presidential address to this subject. In the course of his discussion he tabulated the number of practicing, broadly qualified, systematic "experts" for each of the major phyla or larger classes. He further pointed out that many major groups were not served by a living specialist and that only a few were served by more than one man. This shows that there is room at the top for paleontologists. Also the fact that many colleges and universities have been unable to fill open positions for paleontologists further indicates an opportunity for beginners.

Following this general prospectus of activity in paleontology, I would like to briefly discuss a few individual projects which I think are of particular interest to geology teachers. This list of projects, of course, is by no means complete, and many significant and worth-while works have been omitted. In so far as possible inaccessible or very recent works that may have escaped the attention of practicing teachers have been selected.

Tyler and Barghoorn's (1954) report of five morphologically distinct microorganisms from the Middle Huronian Gunflint formation is a highly significant addition to our knowledge of Precambrian life. According to Helium measurements, the southern Ontario rocks containing these fossils are 800 to 1650 million years old at a minimum. This makes them the oldest known structurally preserved fossils. They are amber brown, translucent to opaque and are preserved in fine to medium-grained chert in a manner similar to the plant fossils of the Rhynie chert. These Precambrian fossils show cellular differentiation, and chemical analysis indicates that original carbon complexes are preserved.

Two algae, two fungi and a probable unicellular calcareous flagellate comprise the assemblage. One alga, consisting of free, unbranched filaments, lacks

heterocysts or spores and is similar to *Lyngbya* or *Oscillatoria*. The second alga is a colonial actinomorphic aggregate imbedded in what is apparently a silicified mass of jelly. This plant resembles modern *Rivularia* but is distinct from it. Many-branched, apparently non-septate hyphae with small, sessile, laterally attached spores characterize one of teh fungi. The other consists of matted, non-septate, many-branched hyphae accompanied by non-attached spores. Additional free spores are noted which have reticulate structure. The remaining unicellular organism is represented by platelets, of which one kind resembles a modern coccolith—*Discoaster*.

Geochemical studies are also significantly advancing knowledge of Precambrian life. Although this work is not paleontologic in the sense that remains of recognizable organisms are involved, the information and the inferences derived from it should be part of any historical geology or general paleontology course. Swain, Blumenthals and Prokopovich's (1958) study of bituminous substances in Precambrian rocks from Minnesota is a good example of this work and is a readily available introduction to the subject. These workers have recovered small quantities of bituminous substances from the following Precambrian rocks:

Thompson slate (Knife Lake)—Early Precambrian—200 ppm of colorless oil, possibly hydrocarbon.

Rove argillite (Animikie)—Later Precambrian—180 ppm of bitumen, probably not hydrocarbon.

Rove graywacke (Animikie)—Later Precambrian—450 ppm of possible hydrocarbons.

Cuyuna argillite (Animikie)—Later Precambrian—380 ppm of bitumen, low in presumed hydrocarbons but high in asphaltenes.

Test runs of related igneous rocks from the same area yielded significantly smaller amounts of bitumen and it was therefore concluded that these very small quantities of bitumen were original constituents of the rocks. Furthermore, the presence of humic acid and carbohydrate deriviatives suggests that differences in bitumen composition result from differences in the environment of deposition rather than metamorphism. Thus the low tar and high saturated hydrocarbon content of the Thompson slate bitumens is believed to represent a nutritionally poor environment. This is in contrast to a hypothesized normal marine environment inferred for the Cuyuna argillite on the basis of its high tar bitumens. Study of carbon-nitrogen ratios suggests that the Cuyuna and Rove bitumens are derived from protein-rich organisms, but that the carbohydrate-rich material in the Thompson slate might be more likely derived from peridinean dinoflagellates.

A little-known contribution of possible great significance is that of Krishtofovitch (1953) who reports the discovery of an apparent lycopsid plant in middle Cambrian rocks of the Aldan Mountains of Siberia. Four specimens of the plant, *Aldanophyton antiquissimum*, occur together with the trilobites, *Prohedinia attenuata, Ptychoparia tchabdensis, Anomocarioides limbataeformis* and *Hypagnostus truncatus*, which, according to Krishtofovitch, indicates correlation with the *Para-*

*doxides forchhammeri* zone of the early Middle Cambrian. This, of course, establishes *Aldanophyton* as a Cambrian fossil.

Krishtofovitch describes *Aldanophyton* as a fairly large plant that appears related to *Drepanophycus* and *Baragwanathia* on the basis of external characters. The main shoot is 8 to 13 mm wide and the longest specimen is 8.5 cm long. Its surface is covered with irregular elongate ridges and with thin, delicate "leaves" up to 9 mm long. Maceration failed to recover cuticle, pellicle or spores and sectioning showed no obvious cellular structure. Traces of carbonaceous material are, however, present in the rock. Thus the evidence presented by Krishtofovitch, though not incontrovertible, strongly indicates that lycopsids originated at least as early as Cambrian time. This is the oldest known record for a higher plant.

Continuing with paleobotanical advances, the biologic affinities of *Glossopteris* and *Gangamopteris* of the Gondwana flora have long been unknown and of great interest, and new information is now available regarding this problem (Plumstead, E. P., 1952, 1956a, 1956b). *Scutum* and *Lanceolatus,* fruiting bodies discovered by Mrs. Plumstead, are respectively attached to leaves of *Glossopteris* and *Gangamopteris* from Vereeniging, Transvaal, South Africa. *Ottokaria,* previously described from India, also occurs at Vereeniging attached to leaves of *Gangamopteris.* All of these fructifications are attached to the midrib of the leaf in an axillary position. In the case of *Scutum* abundant material is available and bisexual flowers, smooth-coated, angiosperm-like pollen, a possible stigma, enclosed seeds in the fruit and a phyllospermic closed cupule, serving as a carpel, all have been observed. Most of these characters also are known in *Lanceolatus* and *Ottokaria.* Furthermore, the simple reticulately veined leaves have an angiosperm-like cuticle. This along with their angiosperm-like fruits leads to the conclusion that *Gangamopteris* and *Glossopteris* are more closely related to angiosperms than gymnosperms as previously has been believed. Mrs. Plumstead thus advances the idea that her new class, Glossopteridae, may be the ancestral stock of the angiosperms.

Further new data bearing on the origin of the angiosperms are presented by Brown (1956) in the form of palm-like plants from the Triassic Dolores formation of Colorado. These fossils consist of leaves, approximately one by two feet, of lenticular outline. About twenty strong, sub-parallel ribs converge at the apex and base and are separated by finer, sub-parallel ribs or veinlets. Brown names the fossil *Sanmiguelia lewisi* and points out that, although it may belong to some other monocotyledenous genus, it is almost necessarily a primitive palm. Thus it is the oldest known megascopic angiosperm and helps bridge the gap between Mrs. Plumstead's Glossopteridae and the Liassic palms of Normandy.

Paleontologists are often prone to forget that fossils are remains of living organisms in their general preoccupation with the stratigraphic applications of paleontology. Inasmuch as fossil foraminifera are of preeminent economic importance, the work of Arnold (1953, 1954) with *Allogromia laticollaris* has special interest to paleontologists. Arnold has made a complete study of the life history of this living foraminifer and has discovered, among other things, great morphologic variation within laboratory cultures. The species is generally single chambered, spherical and has a single test aperture. In the laboratory, however, some

individuals appear with multiple apertures for as yet not understood reasons. In some of these aberrant individuals lobation, generally temporary but permanent in some cases, apparently results from distortion of protplasmic flow patterns associated with the multiple apertures. Also animals grown on semi-solid media in the presence of algae uniformly produce flattened tests. In addition, stellate, tubular, rectilinear, coiled and uncoiled morphologic variants occur in cultures of various types. Study of the development of these variants shows that they follow a wide variety of paths in ontogenetic development. Furthermore all of this variation, both in adult form and in ontogenetic sequence, apparently may appear or be induced in colonies derived from single individuals of any particular character. Inasmuch as these forms mimic most of the basic plans of foraminiferan test morphology, it may be deduced that specific and generic concepts based on shell shape —which includes all fossil foraminifera—are based on insecure biologic criteria. The complex ontogenetic relationships of some of the morphologic variants further suggests that the phylogeny of the various foraminiferan groups must be complex. Any given body form or chamber arrangement apparently must be potentially derivative from almost any ancestral type. This, of course, is of fundamental importance and indicates that a critical reevaluation of foraminiferan micropaleontology is in order.

Lemche's (1957) description of *Neopilina galathea,* a living member of the Monoplacophora, reports a discovery that is, perhaps, more improbable than the recent find of a living coelacanth off the South African coast. The Monoplacophora were previously believed to have become extinct after the Silurian Period! *Neopilina* is a small, cap-shaped mollusc having a single dorsal shell with a dextrally coiled apical nucleus. There are five well-developed metameres in the body and three in the head. These segments are represented by five separate muscle scars on the shell in the body region and a coalescent group of three pairs of scars in the head region. This is similar to the Silurian *Pilina,* and in fact the similarity of these two shells leads Lemche to state "that the differences may prove to be of only subgeneric value."

The soft parts of the animal have not yet been thoroughly studied, but Lemche reports that the radula resembles that of the Solengasters, the intestine is coiled, there are five pairs of nephridia and the sexes are separate. Also the nervous system is not rotated. Tentacle-like appendages in the mouth region apparently serve as filtering agents and, perhaps, chemical sense organs. On the basis of the Solenogaster-like radula and gastropod-like shell, Lemche concludes that *Neopilina* is a very primitive link between the Polyplacophora and nautiloid cephalopods. Furthermore, he points out the interesting similarities between a typical annelid segment and the gill-bearing region of *Neopilina.*

A final interesting curiosity is Palmer's (1957) description of silicified Miocene insects from California. These remarkable fossils are the third known instance of fossil insects separable from matrix. Palmer recovered seventeen species of aquatic and terrestrial arthropods including fairy shrimp, spiders, mites and insects. These fossils are preserved as silicified replacements in limestone nodules from non-marine Miocene clastic and evaporite rocks near Barstow, California.

Many of these fossils display internal structures such as trachae, genitalia, brains, muscles, malpighian tubules, rectal gills, parts of the alimentary canal, and the heart. As a result the collection has been studied and classified according to the same criteria as those applied to living insects. This is most unusual with fossil material.

In conclusion I would like to acknowledge the help of my colleagues at the University of California in assembling materials for this note and for my presentation at Redlands. Mr. Jack Wolfe, Prof. J. Wyatt Durham, Prof M. C. McKenna and Prof. W. L. Fry were especially helpful. I would also like to express my appreciation to Prof. Norman H. Dolloff, Prof. A. O. Woodford, and the general membership of the Far Western Section of the Association of Geology Teachers for the invitation to present this material to the Association at Redlands and in the Journal.

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# AN ECONOMICAL COMPASS AND CLINOMETER FOR BASIC GEOLOGY COURSES

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ABSTRACT. The writers believe that actual practice in basic field mapping enables students to gain a better understanding of abstract spatial relations necessary for intelligent interpretation of topographic maps. They therefore introduce this practice in the laboratory of their first year course.

Since it would not be feasible to equip each member of such a class with a standard compass and clinometer, a simple, inexpensive instrument was designed that has proved satisfactory in use. This paper gives specifications and directions for its construction.

Most geology teachers who have faced the problem of teaching a first year class enough about topographic maps to enable them to use and interpret them intelligently will agree that, due to a lack of understanding of abstract spatial relations, the most difficult concept of all to the student is that of contouring and the relation of contours to the actual shape of the land surface. In many cases, even though the mechanics of contouring are eventually mastered, students still will not be able to read a contour map, nor understand the source or significance of "all those little numbers we contour." With this in mind, the senior author introduced basic field mapping into the practical (laboratory credit) part of his first year geology course (Norton, p. 55-63, 135-140).

It would ordinarly be neither economically feasible, nor practical to equip each member of a first year course with a standard geologic compass and clinometer. Initially, therefore, all mapping was done utilizing a straight edge and simplified clinometer made from a "dittoed" protractor, a piece of 2″ by 4″ wood, a tack, a piece of string, and a pencil or pen for a plumb bob. Using this basic equipment and working from a measured, oriented baseline with a known elevation at one end, the student could locate points by triangulation or pace and bearing from his oriented map board, and determine elevations by the "step" method (Lahee, p. 432, fig. 383) or by measuring the angle of elevation and then employing trigonometry.

While these simple procedures proved reasonably efficient—most students producing respectable maps and learning the practical application of the contouring they had previously studied in the laboratory—it seemed obvious that a more rugged and sophisticated mapping device was desirable, especially if the technique of teaching mapping by "doing" were to be extended to include geologic maps. What was needed, then, was a device embodying both compass and clinometer which would be economical to make, easy to repair, and rugged enough to withstand the heavy use and abuse to which it would be subjected by the average student. With these specifications in mind, plans were prepared, and a simple device constructed.

The structural material used is 1/16" plexiglas which has the necessary strength, lightness, and transparency, and can easily be cut using a saw or knife and glued with either ethylene dichloride or any suitable cement. The outside shape of the device is a box 4" by 1½" by 2½". It is divided into upper and lower compartments by a horizontal platform 2" from the bottom. A compass is mounted on this in proper orientation and occupies the upper compartment. The compass parts (pivot and needle only) can be obtained from any small, inexpensive pocket compass. The regular compass card may be used, reversing E and W by putting lettered squares of tape over them and instructing the students to be sure to measure bearings from N or S. If the compass card is calibrated for reading azimuths, it may be used by instructing the students to read all azimuths directly from the compass card, and then correct them by subtraction from 360°. Both of these makeshifts, however, provide an added mental hurdle for the student, so it is preferable to make a new compass card suitable for taking bearings or azimuths. These can easily be produced in quantity on any duplicating machine.

Directly beneath the compass hanging by a thin cord is the clinometer weight. The length of the clinometer cord is adjusted so as to have the lead weight hang near to, but not directly touching the clinometer gauge. This is a rectangle 3⅞" by 2" with a semi-circle of radius 1½" cut symmetrically from one long side. This semi-circle is then calibrated in degrees upward in both directions from the zero point directly below the clinometer weight in its position of rest, and cemented into the lower compartment bisecting the narrow dimension.

## CONSTRUCTION

The base, two narrow sides (ends) and clinometer gauge are cemented together and allowed to dry. The compass card (alligned with N-S direction parallel to the clinometer gauge) and pivot are cemented to the compass platform and the clinometer cord fastened to the under side. Next, the compass platform is cemented above the clinometer gauge, the compass needle placed on the pivot, and the top and two sides placed in position and cemented. The top should be at a height which will prevent the compass needle from falling off the pivot, even when the instrument is turned upside down; for the average pocket compass needle and pivot, the overall dimensions suggested above will assure this.

The overall cost of the materials used should be well under one dollar per instrument and, if the parts are purchased in quantity, probably less than fifty cents. The time required to prepare and assemble a single instrument, exclusive of drying time for the glue or cement, is in the order of half an hour.

Bearings or azimuths are taken in the usual way (Lahee, p. 424-428). There is no adjustment for setting the compass to local declination, so all readings are with reference to magnetic north; a whole map may be drawn using points determined in this way and then corrected by properly orienting it with true north up and marking on two arrows, one pointing to true north and the other to magnetic north.

The determination of accurate dip and strike readings are simpler with this instrument than with a standard field compass and clinometer. The true strike of a bed may be easily determined by sighting, or by placing one long edge of the instrument tangent to the bed in such a position that the plumb bob both points to zero and is also in the plane of the clinometer gauge. In the latter case, if a mark is made on the rock along the line of tangency, the true direction of dip will then be at right angles to it and may be read by rotating the instrument 90° so that its narrow side is parallel to the marked line and placing it flush on the bedding plane. Dips and angles of elevation may, of course, also be read by sighting directly.

Repeated field tests have proved the accuracy of both compass and clinometer to be well within allowable limits of error for ordinary field work and, indeed, to be comparable in all ways with standard field equipment.

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## BOOK REVIEW

*Geology of the Great Lakes*, Jack L. Hough, University of Illinois Press, 1958, 313 pp. $8.50.

In the *Geology of the Great Lakes*, Dr. Hough presents the most complete summary of geological information on the Great Lakes since Leverett and Taylor's monograph of 1915. The fact that 180 of the entries in the bibliography bear dates subsequent to 1915 attests to the considerable body of information that had accumulated in the interim. The new book does not supplant the publications of earlier investigators but rather supplements them. Where the author accepts the evidence and conclusions of Leverett, Taylor and others, these are used as a point of departure. Indeed, to keep his synthesis of Great Lakes' history within the modest limits of this volume, details of even his own investigations are not fully discussed. Anyone interested in these must still go to the original studies.

*Geology of the Great Lakes* is divided into two parts: The first is a brief review of conditions within the modern lakes and the history of the region prior to the appearance of the first pro-glacial lakes in the southern basins. Part two, which makes up a little over half of the book, is a discussion of the lake stages with suggested correlations of those in different basins. By Dr. Hough's admission the purpose of the book lies within the pages of this second part. Part One then must be regarded as something of an afterthought, although this is not to say that valuable summaries are not contained in it. I have in mind particularly the chapter on composition and movement of lake waters and fluctuations of level.

Small scale maps in the back of the book are useful in that they show the outlets and extent of the lakes at the various stages, but this reader felt the lack of a map with key place names for general use with the text.

*Continued on page 24*

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# PROBLEMS OF THE GEOLOGY TEACHER AND HIS ASSOCIATION

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Mr. President, Fellow Members of the Association of Geology Teachers, Colleagues, Friends:

First, to express my most sincere appreciation to the Association for the Neil Miner Award. Taken by itself, receiving this citation would be a very high privilege indeed. But my pleasure is trebled when I recall the names of earlier recipients: Fritiof M. Fryxell, William H. Shideler, Alfred O. Woodford, Armin K. Lobeck, George A. Thiel. All of these are men whom I have known and whose works I have admired may years; several I count as close friends. Each in his own way has made great and lasting contributions, not only to the basic knowledge in his own field—glaciology, paleontology, petrology, geomorphology, sedimentation and related subjects—but notably also to the teaching of the science and to the rapport between their own generations of geologists and the succeeding younger men and women--a relationship which is the peculiar function of the teacher. I am most fortunate indeed to be allowed, by implication at least, to join that distinguished company. When to this is added, as I have been informed by the President, the privilege of addressing what I fear must be regarded as none other than a captive audience, and am told that I may speak on any subject dear to my heart and say anything I wish without rebuttal from the almost certain opposition, my cup truly runneth over!

In the past thirty years we have witnessed an astounding germination of societies devoted to various aspects of the earth sciences. We even have two that both call themselves "S.E.G.". Luckily, the Association of Geology Teachers is the only one which, as its name indicates, is manifestly and fully devoted to the problems of the teacher! It is most fortunate that we teachers are "all in this thing together", for as teachers we all have several major tasks ahead that may prove insuperable. On two of these, separate but really related, I propose to touch, (1) keeping ahead of our students and (2) quantity of demand and quantity and quality of supply. I trust I may do so frankly, as among friends. Despite the sort of license accorded me on this occasion, nothing would please me more than to hear my statements hotly disputed from the floor.

The *first major problem* is that of keeping ahead of our students, and I mean this in two senses. One sense is the fairly obvious task of doing what the teacher is supposed to do—knowing more than his students know! But the variety of

* Address on the acceptance of the Neil Miner Award.

backgrounds required to be a competent teacher of an earth science far transcends that, for example, of 35 years ago, when I was a graduate student. Consider only the implications of such terms for subdivisions of our science as biogeochemistry, paleoecology, paleomagnetism, palynology. Most of us recognize that at least a moderate grasp of what these words mean calls for fundamental training in botany, chemistry, mathematics, physics, zoology—the kindred but, for us geologists, more basic sciences. Such subjects, as every geology, geophysics, and geochemistry teacher doubtless recognizes by now, are needed in the four undergraduate years, but to introduce them into the geology curriculum at the collegiate level may necessitate a sanguine battle with a colleague who wants his undergraduate students to help him do research or with a department head who, for budgetary or prestige reasons, wishes to expand the "offerings" in the earth sciences. Or the opponent may be a dean who insists on sacrificing much of this basic professional training for what in this respect are almost extra-curricular (though in themselves highly desirable) activities, such as a course on religion or on the appreciation of my favorite art—music. These and kindred subjects are appurtenances of the well-rounded man, but, like college activities and athletics, should be compelled to justify their place in today's crowded educational pattern, especially with due regard to the student's background and objectives. Why a course in musical appreciation for the composer's son? Or in German for one who used it as a native?

Naturally, the basic training in kindred sciences may provide our students with a background frequently better and embarrassingly more modern than our own. I am reminded of the story of the distinguished physician Sir William Osler, who attended a meeting of the students and faculty at an outstanding medical school at which the curriculum was discussed. He was heard to remark to a colleague, "Aren't we lucky to have gotten in here as faculty? We never would have made it as students!" At least, when we have such feelings, we can know that the yeast is still working, that we are moving forward, and that things are as they really ought always to be in the educational world!

But there is a wider and even more important sense in which we must try to be ahead of our students—in planning for them as of 20 or 30 years hence. What will the mind of the well-trained geologist wear in 1978? Will it be more chemistry? More biology? If so, of what kind—more thermodynamics, or more genetics? Will some of the technique courses given today have been justified three decades hence—for instance, the use of the plane table or the flame photometer—or will plane-tabling or flame photometry be carried out by technicians, trained and employed for the purpose? Are courses in regional geology as such ever justifiable except perhaps as vehicles for embodying and emphasizing principles, as compared with proficiency in Russian or German or mathematics? The values involved are relative, of course, and such questions can therefore not be tersely answered, but they should be debated thoughtfully and repeatedly, perhaps with digests of current findings distributed gratis to departmental chairmen, deans, and presidents! The very best auspices for a debate of this kind would be furnished by this Association at its annual or local meetings, with such "outside" speakers as can contribute illumination on curricular possibilities and needs. I am reminded,

for example, of excellent papers by a practicing petroleum geologist and a practicing geophysicist, both given before this Association to overflow audiences.

The *second major problem*—an even more pressing one, to my mind—that faces us teachers is that of the quality and quantity of young American geologists—the adequacy and nature of the supply in relation to the existing and expectable demand. A wise solution of this problem calls for a kind of planning that we Americans regard as onerous, not to say downright obnoxious. The depression (or should I say, "recession"?), insofar as raw mineral materials are concerned of the last dozen months, however, has pointed up its timeliness. One of our most forward looking and successful mining companies has had to reduce its geologic staff to 25% in a period of three years; one of our largest oil companies is dropping from parts of its scientific and technical staffs all personnel with less than two years of service record. If such trends continue for a time now or in future periods, how shall we place our well trained students? How forecast the demand for such young men? The answer to the teacher engaged in student placement is frequently presented in this form: if he's good and has a Ph.D. he will find employment. For the above-average candidate this probably suffices. But meantime, how does he establish his outstanding capacity, and will the statement be more than a promise in a year of depression?

There are obviously many aspects of this dilemma that transcend our sphere of direct influence as teachers, though perhaps not our responsibilities as geologists and certainly not our rôle as citizens. A most basic question is how to stabilize our mineral industries, and this in turn is dependent on such other factors as our presently highly vacillating tariff policies, the adequacy of current incentives for exploration offered to mining and petroleum companies, and the relations between mineral exploitation and various defense considerations. Thence the trail leads through a maize of diverse issues. For example: precisely what is meant by the conservation of natural resources—is it not the best conservation if we *use* a raw material, provided we use it fully? Again, is competition *really* always good—in business, in scientific work, in study and teaching? Does it not frequently condone waste of human energy and falsification of fact and, most of all, lead to a decline in the high standards of social conscience which we as teachers should do all we can to encourage?

Obviously these are not matters for this Association to settle, much less for me to discuss presumptuously here. The signs, however, as to the quantity of professional geologists needed, point to continued large fluctuations in demand, with crests like those of three years ago and troughs like the present. We may pray that the period from 1929 to 1934 will not be repeated. In any case, at most a fairly steady growth of demand can be anticipated, or at least hoped for, but certainly not the great mushrooming of openings that has characterized some other sciences of late. By comparison, statistics recently published in "Geo-Times" by the American Geological Institute seem to show a continued increase of about 18 percent in earth science Ph.D. anticipants, despite the decline in non-teaching professional openings; the surplus will perhaps be absorbed in the teaching profession. Is this healthy if such entrants are merely teaching to be earning a living? The

profession of teaching, especially at the undergraduate level, is marked by features that distinguish it from applied work on state or federal surveys or for petroleum or mining companies; despite exceptions, a moment's reflection will yield many examples of persons we know who have been miscast by circumstances to prove the general correctness of this statement.

How, then, are we to find outlets for our students, how reduce the chance of delayed employment or even of unemployment with their tragic effects on the morale of all professional geologists? We might, of course, consider a kind of professional rationing, except that it is so obviously impractical: the entering classes vary from year to year and colleges themselves rise or decline in time and capacity. A more effective attack would be the development of a national placement service. The employment columns of the "Geo-Times" have been invaluable in placing young geologists. The American Association of Petroleum Geologists has an active campaign with extensive programs for helping to place young people: in 1956 some 43 employing organizations participated and 191 persons representing 82 schools were recorded as having sought interviews, though the figures were doubtless far too low; in 1958 at least 172 interviews were held. The problem for that organization, being specifically related to petroleum, is relatively simple but is most admirably faced. The American Institute of Mining, Metallurgical, and Petroleum Engineers covers a wider, less well defined front, at the same time touching few geologists and geophysicists; it has, for various reasons, shared in setting up a separate Engineering Societies Personnel Service. Except for the most generous and constant personal efforts of its Secretary, our friend the Geological Society of America has been slow in officially recognizing this as one of its responsibilities; as its youngest and most energetic offspring, perhaps brash but certainly imaginative, we can probably stimulate it to action, particularly in the employment of teachers. Indeed the annual meetings of the Geological Society of America indubitably bring together more teachers, departmental chairmen, and the like, concerned with teacher placement in the earth sciences than any other group in the country.

In passing, we might take a long look at the medical profession, with its manifold methods for continually raising standards while generally tending to restrict the output of physicians to a point where at least the production of young doctors does not greatly exceed what the traffic will bear.

However, another approach to the danger of over-supply is justified for a quite different reason than that of employment. This is on the score of quality. We must raise our standards of entrance into professional study at each of the levels we, as individual teachers, touch: the college geology "major", the A.B. or B.S. who graduates in geology or geologic engineering, the M.A. or M.S. recipient, and the Ph.D. I believe we have been inclined too readily to blame the high schools for our shortcomings, as Dr. James B. Conant recently pointed out. A raising of entrance standards will not only raise the level of college and graduate work but will also, slowly but surely, affect high school and grade school standards more lastingly, if less ostentatiously, than the direct approach of trying to work on the primary and secondary school level, though that, too, is welcome where it can be instituted. At any rate, we college and university teachers *can*

work through the college or university, even if the other avenues are closed. Two subtle, almost imponderable qualifications that should be more widely heeded in our science are motivation and adaptability of the young geologist-to-be—especially adaptability if we are discussing a petroleum or mining career. When academic tests are added, the selective process can operate to produce the best men and also, as a desirable by-product, to avoid the over-production that otherwise generates excessive competition for the moderate quotas of available openings to be anticipated.

In brief, it appears to me that we need more planning—of individual courses and of course sequences in the immediate present, of all phases of the curricula for the long-term future of the earth sciences, and of the ways in which standards can be raised and, incidentally, over-production of young men and women trained for the profession can be avoided. Thus will be maintained a balance between high quality and moderate supply as opposed to an excessive production of half-baked professionals. This type of planning seems to me the *major* function of the Association of Geology Teachers. I am proud to have received recognition from this Association, which, by its very name, accepts the major responsibility for facing and solving problems like these, of paramount importance to scientific progress and to the young men and women entering the earth sciences.

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WILLIAM H. SHIDELER, 1886-1958. Dr. William Henry Shideler, Emeritus Professor of Geology at Miami University died suddenly of a heart attack on December 18, 1958. After receiving an A.B. degree from Miami University in 1907 and a Ph.D. from Cornell in 1910, "Doc" Shideler returned to Miami to begin a distinguished teaching career that lasted for forty-seven years. In 1920 he was appointed Chairman of the newly established Department of Geology. After his retirement at Miami, Dr. Shideler accepted a John Hay Whitney fellowship and established a Department of Geology at Hiram College. For several summers "Doc" taught geology at the University of Michigan and worked for the Ohio and Kentucky Geological Surveys. A paleontologist, Dr. Shideler was an authority on Upper Ordovician fossils and stratigraphy and contributed substantially to the placing of the Ordovician-Silurian boundary. Dr. Shideler was very active in fraternity work and in athletics and was in great demand as a lecturer and speaker before professional and other groups. He was a fellow of the American Association for the Advancement of Science, the Paleontological Society, the Geological Society of America and the Ohio Academy of Science. In addition, he was a member of five social and honorary fraternities, the Sigma Xi, the Indiana Academy of Science, the Kentucky Geological Society and the National Association of Geology Teachers. The death of Dr. Shideler deprived the Association of an active and enthusiastic worker. He was president of the East Central Section in 1955 and that year he was the recipient of the Neil Miner award.

WAYNE D. MARTIN.

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# THE PRESENT STATE OF GEOLOGICAL TERMINOLOGY

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ABSTRACT. Preparation of the AGI Glossary of Geology and Related Sciences has provided an opportunity for study of the state of our means of communication among ourselves and to the public. This note attempts to call attention to some glaring weaknesses and to point out means of avoiding future offenses.

Criticisms are made of the following procedures: (1) Introduction of new terms to replace old and well-understood words, (2) Redefinition of old established terms, (3) Proliferation of new terms for features or concepts readily defined in simple non-technical words, (4) Use of terms so vague that definitions must always accompany their appearance, (5) Coining of terms containing both Greek and Latin combining forms.

Geology has been afflicted with these evils for many years, but great expansion in numbers of geologists and publications of recent years has served to aggravate the condition. While the use of the Glossary should prevent further use of old terms for new things, only careful study of the pertinent literature will enable an author to avoid the sin of applying new names to old things. At least until the material of the Glossary has been organized into Thesaurus form, the burden rests solely on the author himself.

Communication—the conveyance of scientific knowledge both by the written and the spoken word—is a subject on which many books have been written, yet the problem has not yet been solved, and as science expands it becomes more than ever necessary that we apply ourselves to its solution.

Since what I shall have to say may be considered to be a preachment (defined by Webster as a "tedious discourse") may I be permitted to select a text? Following Sir Ernest Gowers (in Plain Words, p. 145) let us consider the words of St. Paul:

"For if the trumpet give an uncertain sound, who shall prepare himself for battle? So likewise ye, except ye utter by the tongue, words easy to understand, how shall it be known what is spoken?"

From 1785 to 1918 I find listed but one paper critical of new terms in Geology, that being by J. C. Branner in 1897 (Science N.S. 5, 912-913 and 133-134, 1897), from which I propose to quote and to which I refer my readers. Between 1919 and 1952 many appeared, all suggesting numerous new terms, but few criticizing the increasingly complicated terminology which was being developed. Perhaps improvement finally has begun, for in 1952 appeared a paper by Dr. F. P. Shepard on depositional coastal features, while J. E. Eaton, 1951, Kenneth Cottingham, 1951, and F. B. Van Houten, 1949, pointed out the unfortunate situation which geologists are creating by their careless usage of terms, lack of respect for long established usage, and appropriation of old terms for new purposes.

But the actual state of affairs was not made clear until the advent of the AGI Glossary in June 1957. Here for the first time, for all to see, are all of the incongruous terms, duplications of terms used for the same thing, and multiple uses of the same term for several things. Some of the worst of these are to be pointed out here, the others can be found by scanning the pages of the Glossary.

Perhaps the best example of the apparent indestructibility of bad usage is that of the shoddy triumvirate of potash-feldspar, soda-feldspar and lime-feldspar, and their tricky cousin, soda-lime feldspar. When the writer studied Petrology over forty years ago he was cautioned concerning these terms and their obvious faults pointed out. Yet they still appear to be in circulation and not always in bad company.

An effort has been made to set forth the causes which have produced the terminologic confusion complained of. At least nine have been recognized, as follows:

1. Ignorance concerning earlier usage. The Glossary should do much to forestall future offenses.
2. Dislike of an earlier term and effort to replace it, despite widespread usage.
3. Careless reading of the original definition and assumption that its meaning differs from that intended. (e.g. Monocline)
4. Failure to make thorough search of earlier literature to determine whether object, feature or substance has been previously named. (e.g. Hornfels)
5. Seemingly deliberate attempt to apply a well known term to a different thing. (e.g. Quartzite)
6. Re-introduction of a long unused ambiguous term to apply to a definite feature. (e.g. Graywacke)
7. Re-definition of a well established term to apply to a part of, or more than, the original usage.
8. Failure to realize that Greek and Latin combining forms are kept apart, if only for the sake of euphony.
9. Lack of awareness of the fact that introduction of new terms for old concepts is not progress but confusion.

Remedies for these past offenses are few but eventually they may prove effective. They may be summed up as follows:

1. Let committees in each of some 25 branches of Geology designate preferred usages, although it is realized that strict unanimity may be difficult to obtain.
2. Let clearly objectionable terms (or usages) be similarly designated as "unacceptable" or at least as "not recommended," or "incorrect," or "obsolete."
3. Let editors of geological publications be urged to follow these recommendations.
4. Permit no new terms to be accepted for publication in scientific journals until the appropriate committee has been consulted.

Since none of the above remedies can be applied retroactively, except through the agency of a glossary, it is urged; (1) that if at all possible the 2nd Edition be made the instrument for removal of objectionable terms and usages, and the work of the Revision Committee be expanded into the field of *preventive medicine;* (2) that the Glossary Revision Committee be consulted prior to publication of new or altered terms and usages, rather than after they have been embalmed in the literature, to the confusion of future generations.

And it might be well to point out also that as soon as the meaning of a well known term has been altered, restricted, or expanded, it immediately occurs to some eager soul that a new term is urgently needed to replace the original one and thus the confusion is triply confounded, future students confused and glossary editors driven to distraction. A typical instance is that of monocline, used at least since 1842 to designate "a relatively uniform dip in one direction for an indefinite distance." When R. A. Daly mistakenly assumed that Dutton's term "monoclinal flexure" was equivalent to monocline, he filled the supposed void with the term homocline, having the exact meaning of monocline, as the latter had been used for generations.

Right here it might be well to quote from the paper by Dr. J. C. Branner, which appeared in Science (N.S. vol. 5, No. 128), in 1897, in which he says:

"Sometimes the desire for innovations, when it can find no other changes to make, gives an old term a new meaning or substitutes a high-sounding word for a simple one. Occasionally these terms are poured forth in such quantities that it looks as though their author had certainly invented a new science."

Branner, in the paper quoted, adds another bit of wisdom that should not be forgotten, namely "a little thought will convince anyone that geology—not an exact science—can never have a logical and precise system of terms." . . . Also that "the fixity of a nomenclature is of much more importance than any logic or special fitness of the words themselves."

As an example of the confusion readily attained by use of multi-meaning terms there may be cited a recent publication by one of our better State Surveys in which the term granulite is used to designate a metamorphic rock. The AGI Glossary lists eight meanings for this term.

In recent years petrographers have begun to use the term "emplacement," seemingly applying to the process by which batholiths and laccoliths reach their present sites. I have found no exact definition and the term was not included in the Glossary in that sense. Unfortunately, it has now been adopted by students of ore deposits who apply it to localization of ore minerals whether deposited by hydrothermal solutions, ground water, meteoric waters, or by syngenetic processes. In effect, it is being used to supersede the old general term "ore deposition." I hold no brief for or against this term but cite it as an example of substitution of a new term for one which has had a long, honorable, and useful life.

Let us, as geologists, clean up and keep clean, our own terminologic jungle, refrain from adding to the present confusion, and make easier the path of future geologists. Teachers can be of most assistance in this by avoiding controversial

terms or at least pointing out to their classes the confusing usages and recommending preferred ones. Perhaps the next edition of the AGI Glossary may initiate the practice of recommending terms for use or for extinction.

Certainly many of the difficulties encountered in college classes stem from mediocre preparation in high schools and elementary schools. But admittedly the scientific disciplines are not wholly innocent, for the reason that terminology, at least in the geological sciences, is inexact, and all too often permits use of a term in several senses, or of several terms for the same thing. If you feel that I exaggerate I suggest you consult the Glossary for definitions of greywacke, hornfels, reef, basin, bed, dome, drift, pericline, furrow, granulite, hogback, hinterland, still, nappe, sole, ramp, rift, stone ring, and swell. There are many more, but these illustrate the points which I am trying to make.

Geology is a rapidly growing and advancing science and the volume of geological literature is increasing at an equal or greater rate. The stabilization of our terminology is of prime importance if the future generation is to understand the reports of past ones. With a choice available from the nearly 14,000 listed in the Glossary or the several hundred coined since January 1957 or inadvertently omitted from the first edition, it does appear unnecessary to introduce many new terms unless, beyond a doubt, a new concept, thing, or process has been discovered. If the birth of such a new term is imminent, the prospective parent is urged to make a careful search of, first the Glossary, second of an unabridged dictionary (for possible previous use of the word in a different sense) and finally turn to that excellent treatise "Composition of Scientific Words" by Dr. Roland Wilbur Brown for help in the coining of a term blessed with legitimacy, euphony and specific meaning.

## BOOK REVIEW

*Elementary Seismology.* Charles F. Richter. 768 pp. W. H Freeman and Company; San Francisco, California, 1958. $10.00.

From Professor Charles F. Richter, at the world's hub of modern seismology, the California Institute of Technology, comes this extremely useful book, written for students not intending to become professional seismologists or geophysicists. Geologists, engineers, and advanced students of tectonics and regional geology will find that this volume is a happy hunting ground for information which would otherwise have to be collected from many source books most of which are written in the language of the seismologist.

In Part I (Nature and Observation of Earthquakes) the reader is introduced to seismology with the emphasis on its observational aspects and with enough basic theory to make the discussion meaningful. In Part II (Geography and Geology of Earthquakes) Professor Richter discusses some of the relations linking seismology, tectonics, and regional geology, with detailed data on California, New Zealand, Japan, and several other areas. In Part III (Appendixes) he presents proofs, numerical tables, charts, earthquake lists, and the like; probably these data will be used by those whose interest in seismology is more professional than casual.

Professor Richter has provided an annotated bibliography at the end of each chapter, and a very detailed index for the volume. It is hoped that in future editions the list of symbols will include all of the notation used in the book and that the section on seismic prospecting will be expanded to include a few illustrations showing the common ground between earthquake and prospecting methods.

Warm thanks of the geological fraternity are due Dr. Richter for this contribution.

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# TECHNICAL VAGARIES OF GEOLOGIC LANGUAGE

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ABSTRACT. Teachers should be concerned with (1) unnecessary technicalities in geologic language, (2) substitution of new technicalities for old ones, and (3) multiple meanings of technical expressions. Teachers can perform an important service by pointing out these faults to students. Also editors should be more critical of technical vocabularies.

Living languages and advancing sciences find existing vocabularies inadequate to express new ideas or to identify new things, and new words and expressions are required to meet their needs. This is particularly true of geology because of the increasingly wider range of subjects that are of interest to geologists. In addition to the multiplying technical terms that are exclusively geologic, almost any technicality current in physics, chemistry or biology, as well as other subjects, is likely to appear in geologic speech and writing. Thus, geologists regularly deal with a much larger body of technical terms than any other scientists. This situation poses a special problem in geologic communication that should be of great concern to teachers who attempt to acquaint their students with complicated concepts and prepare them to use scientific literature effectively.

Language is the property of all and anyone is privileged to introduce new terms if he thinks that they are needed. Also nothing can prevent a person from using an old term in a new way. As a rule, most vocabulary additions or modifications eventually win acceptance on their merits or are ignored. This may be a slow process however, and a period of confusion may occur before stability is attained. If this were all that is involved in the expansion of the geologic vocabulary, no very valid objections could be raised and this aspect of communication would not provide an important subject for discussion. Unfortunately three troublesome tendencies complicate the situation and result in unnecessary difficulties. These are (1) use of obscure technical expression in preference to more or less plain English, (2) substitution of new technicalities for old ones, and (3) injudicious use of old words or expressions with new meanings.

Much geologic information can be phrased in relatively plain English. Nevertheless, the impulse to introduce new technical expressions or to invent new words with special meanings is so strong that few of us can withstand it. A highly technical vocabulary may promote conciseness and clarity among experts (if all meanings are agreed upon) but it may be unintelligible to others. The opinion has been expressed that highly technical language addressed to specialists need be of no concern to others. But can anyone be sure that some person outside of his immediate group may not find his presentation interesting, important or even

the inspiration leading to a new idea? Also, memorizing an extensive technical vocabulary is difficult and this effort could be better expended in other ways.

I believe that more attention should be devoted to the simplification, clarification and standardization of geologic language. Is it not more important that we speak or write in a way that is understandable to the largest possible audience than that we create an ever more complex language of our own? Of course, new concepts must be identified but in many instances this can be done within the framework of familiar speech rather than by the coinage of strange neoclassical polysyllables. For example, is *metasomatism* in any way superior to *replacement?* A few more words may be required to express particular ideas but if we consider the convenience of the reader or the listener, these certainly seem to be worthwhile.

A technical expression composed of ordinary English words generally requires explanation to make its exact meaning clear. If the words are well chosen, however, the meaning is then easy to remember which is not so for many coined words based on Greek or Latin. Some English expressions, nevertheless, can be just as puzzling as any neoclassical word and good judgment suggests that obscure or highly specialized private meanings for common words should be avoided.

There is even less excuse for the introduction of new technicalities to replace old ones. An example is the recent rise to popularity of *tectonism* and its derivatives which has forced the old familiar word *diastrophism* into relative obscurity. One very important aspect of this situation is the common consequent impression that a new word identifies a new idea which often is not true. One instance of such loose thinking is provided by the title of a recently issued U. S. Geological Survey folio, "Tectonic Maps of the Jurassic System." Interesting and valuable as this publication is, it contains no map that is tectonic, diastrophic or structural. This title is a complete misnomer.

Perhaps the most difficult tendency to combat is the shifting and multiplication in the meanings of old terms. This has resulted, in part at least, because many authors have failed to provide clear and precise definitions for new terms when these were introduced. Under such circumstances, it is almost inevitable that interpretations have varied and subsequent usages have not been uniform. This is true for both newly coined words and many expressions in ordinary English.

The intentional alteration of meaning or redefinition of a term is another matter and is rarely justified. Any change is likely to meet with disagreement and lead to other changes until a term becomes practically meaningless because it has been used with so many different meanings. *Graywacke* provides an excellent example. Many variations in ideas can be indicated by using appropriate adjectives to modify existing expressions. This practice generally is preferable to using an old expression in a new way except in special or unrelated situations where confusion is unlikely.

Most of us follow fashions in technical terminology to some extent because it seems the progressive thing to do. Many of us have prejudices that either are rooted in habit or indicate that we think we know better than others what a term should mean. A few of us are guilty of pretentiousness and consider that the

use of abundant technicalities is a sign of erudition. Also, there are the careless and ignorant ones who perhaps would do better if they could. These are common human failings that affect us all in varying degrees.

There certainly is no easy solution to the problems of technical communication or the tendency of vocabularies to become bloated with unnecessary or confusing technicalities. I have little hope for the reformation of many mature geologists especially those outside of the teaching profession. Mostly their habits of thought are fully formed and they are not likely to change their ways. A new generation of geologists, however, might be trained in better habits if teachers everywhere make use of their abundant opportunities to point out the unsatisfactory condition of our geologic vocabulary, the reasons for it and explain how these faults can be avoided. In the meantime, editors might be educated to recognize that it is their responsibility to the geologic profession to be more critical of technical language. They should not, of course, be unyielding censors but they might at least insist that all new or questionable terms or modifications in the meanings of old ones be fully and adequately defined.

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*Continued from page 12*

The University of Illinois Press is to be complimented for the pleasing format of the book. Wide margins and clear type give an uncluttered appearance to the pages. The very meager index is a frustration, however, and more careful editing undoubtedly would have removed unnecessary word and phrase repetition that too often adds to the monotony of the account.

The reinterpretation of events of Great Lakes history which Dr. Hough has presented forms a useful framework for further investigation, although there are probably few investigators who would accept it in full. The author admits that some of the points rest on shaky evidence and some are little more than armchair deductions. This is not entirely the fault of Dr. Hough, for in some critical areas there have been on detailed studies, and in others, such as the Ontario basin, much of the interpretation must be based on studies done in the frame of reference of fifty years ago.

In regions where detailed and relatively modern work has been done, Dr. Hough's reconstruction of events often brings him into sharp disagreement with earlier workers. Some of the ideas of Leverett and Taylor particularly have provoked his vigorous condemnation. It is granted that these earlier authors were somewhat more positive on occasion than the evidence warranted, and agreed that such "is out of place in a scientific monograph," but objective as he has tried to be, the author of the present volume has also allowed statements as to the certainty and logicality of events in his chronology to creep in where there is no recognized evidence.

Much still remains to be done before the complete history of the Great Lakes can be written with any degree of certainty, yet at the present time the *Geology of the Great Lakes* is of value for its summary of much of the work of the last forty-five years; for the presentation of a stimulating interpretation of available information; and for pointing up areas in which there is still a woeful lack of any knowledge. It is to be hoped that the next half century will be as productive of results in a field of investigation where all too often "shore erosion has removed all of the old beaches above present lake level in the critical areas."

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# GEOLOGIC WRITING FOR THE NONGEOLOGIST

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ABSTRACT. One of the problems of communication in geology is that of gauging the capacity of the reader. This is difficult enough when we write for other geologists; it is more difficult when we write for the layman or the specialist in another field such as engineering. Audience capacity, plus the use for which the report is intended, will determine the format and terminology to be employed. An engineering-geology report, for instance, may be designed to be read in its entirety or to be used for reference.

In geologic reports, the map is as important as the text. In a report for nongeologists, modification is often restricted to the text, leaving the map in the standard geologic format. Design of reports for special purposes need not stop here. In studies for military engineers it has proved feasible to prepare special-purpose maps showing such things as the suitability of soil and rock for foundations. Much of the analysis involved in preparation of such reports is not presented to the reader because he is not qualified to evaluate it.

There are three problems which beset all of us in our presentation of geologic facts, by whatever means and to whatever audience. They are:

1. What degree of detail is required in various types of geologic exposition?
2. What is the capability of our audience to absorb what we say?
3. What rules should we follow in order to communicate in the most effective way?

The nongeologist referred to in the title of this paper is the working nongeologist: the engineer, military man, city planner, civil defense director. These are responsible people whose work touches upon geology, but who know little or nothing about it.

In terms of the degree of detail presented and the type of audience at whom the writing is aimed, the work of the United States Geological Survey spans the field from highly specialized papers, intended only for a small fraction of the geologic profession, through areal or topical studies of a more general nature intended for all geologists and some civil and mining engineers, to reports prepared specifically for nongeologists, such as those which the Survey prepares for the Corps of Engineers, U. S. Army. For an author to shift from writing one type of report to another requires mental elasticity and literary virtuosity; the following quotations illustrate this. Both have to do with the same area. First, let us quote from a Geological Survey Professional Paper, which is intended to be read by geologists:

"The Matansa Limestone is a pure to impure, inequigranular, clastic limestone containing distinctive Upper Eocene Foraminifera. It includes three principal facies: (1) a basal transitional facies of dull yellowish to red-brown, tuffaceous

to marly limestone and calcareous conglomerate; (2) pink, highly foraminiferal clastic limestones; and (3) white, sparingly foraminiferal clastic limestones.

"These limestones are mostly well indurated and massive to well bedded. They grade from relatively pure calcium carbonate rock to impure or even tuffaceous limestones."

This description continues for five more paragraphs.

Contrast the following, taken from a military geology report on the same area by the same author. This is designed for engineer officers, usually not trained civil engineers, who must know the construction properties of the rocks of the area:

"UNIT No. 1 VERY COMPACT LIMESTONE

*General description:* The rock is a massive, dense, fine-to-course-grained limestone. Its colors are white, pink, pinkish-gray, cream, yellow, or variegated. It is similar in engineering properties to compact crystalline limestones of the United States. Most of this unit is a durable rock. Typical exposures are shown in Plates 6A, 6B, and 7A."

For the purpose of this report the geologic formation name is not used. The main reason for this is that often two or more geologic formations will be combined into one engineering geology map unit.

Notice the simplicity of vocabulary in the second example. It avoids such words as "inequigranular" and "clastic." Sometimes, of course, the tough words cannot be eliminated from a report for the nongeologist. Then a glossary must be appended or the difficult words otherwise explained. But it is surprising how much can be said simply.

In preparing the report for the military engineer, the geologist had to do more than give the brief description and general evaluation that I have just quoted. He had also to delineate the extent of the unit on a map, and to evaluate the rock unit for various engineering purposes. The latter was done succinctly by preparing a table in each box of which one word (excellent, good, fair, poor, unsatisfactory) described the suitability of the rock unit for such uses as concrete aggregate, base course, or fill.

The contrast between the two cited reports illustrates another decision the geologist must make before he starts to write. Is he writing a reference work to make it easy for the user to find a given piece of information; or is he writing a piece of scientific exposition which presents basic data and develops an idea from it, and thus is designed to be read through from start to finish? These are the two extremes; there are gradations between them. It is possible to combine the theoretical with the pragmatic paper, if this is done with care in organization and some shifting of gears as to vocabulary. The U. S. Geological Survey has tried to do this, in some of its geologic quadrangle maps, to which have been added engineering geology tables similar to that mentioned earlier. In the following example a specialized term is used in such a way that the layman can understand it:

"The clay has also been preconsolidated or over consolidated, terms used for the condition in which the degree of consolidation is greater than would be expected from the weight of the sediments overlying the clay today."

This definition of terms in the body of the text is often desirable even for the geologically trained reader.

The opinion has been expressed that publications in applied geology should be made a device for educating the nongeologist: that, in order to get what he needs from the report, he should be led through the geologic reasoning that resulted in the conclusion that he is looking for. With this I do not agree. The military or civil engineer, or anyone else who needs geologic facts in work that is essentially nongeologic, is pressed for time and wants his information briefly and clearly presented. If he needs detail or is interested in true understanding of the geologic principles involved, he will progress on his own from applied geology reports to the fundamental literature.

Having considered the danger of writing beyond the comprehension of our audience, we must also consider the risk, fostered by the necessity for simple writing, of using a vocabulary too small and not expressive enough. The cure for this is the dictionary habit and constant reappraisal of one's writing. Some writers in applied science have tried to solve the problem of expression for the lay reader by the use of barbarisms. The following examples are taken from research and development project descriptions of the armed services:

Ruggedize; miniaturize; breadboard model; prototype hardware development.

It is true that language grows by use, and that the terms just quoted are reminiscent of the alterations in words constantly being made to achieve vividness of expression or to make one word do the work of two or more. Such alterations are common in Beowulf and in the old Scandinavian sagas. Before resorting to them, however, the modern scientific writer must be sure that he is not relying on pat and widely used jargon to express an idea that he does not fully understand himself. Such lazy expression is even more common in talk than in writing. For instance, I noticed a few years ago the increasing use of the word "parameter" in government conferences. Sometimes it was used correctly ("a quantity to which the operator can assign arbitrary values"). More often it was used in a distorted sense, as in referring to the limits of a problem (nonmathematical) to be discussed. Being confused by this, I looked up the word in my 1937 Webster's Collegiate Dictionary. It wasn't there. It had, however, turned up in the 1953 edition. This is an example of the evolution of the language; a mathematical term too obscure to be listed in a standard dictionary in 1937, accepted for wider use in its original sense by 1953, and, then or shortly thereafter, being more and more widely used in a faddish way with a decreasingly exact meaning. This is how a language grows; but scientists, whether writing for their colleagues or for laymen, must adhere more closely than other writers to the exact meaning of words.

In conclusion, here are some suggested rules to govern writing for nongeologists who need geologic information in their work:

1. Determine the degree of detail needed by the reader, and the probable level of his understanding of geologic terminology.

2. Decide on the format of the report: should it be in tabular form or running text, or a combination of both?

3. Decide on the type of map to accompany the report. Will a standard geologic map be understood by the user, and, if so, should it be a bed-rock map or a surficial map? If not, should a special-purpose map of some sort be prepared in which a number of formations might be combined because they have the same physical properties as far as the engineer is concerned?

4. Write simply. Here we come to a portion of his trade which the geologist must begin to learn while still in school. It is not enough that he know the rules of grammar. He should have a feeling for good composition, achieved by reading and by practice. A "theme-a-week" course or a course in creative writing will teach clarity of expression better than a course in technical writing which, although it teaches brevity, tends to perpetuate many stilted writing habits.

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## REPORT OF THE PRESIDENT

During the year a number of matters have come to the officers and the Executive Committee of the Association for action.

In February, Dr. Carey Croneis, chairman of the American Geological Institute Long-range Planning Committee, requested our association—along with the other member societies—to co-operate in evaluating the first ten years' activity of the AGI and to make recommendations for the future, especially in regard to the relations of the AGI to the member societies. The president appointed C. H. Behre, Jr., Kurt Lowe, Chalmer Roy, George A. Thiel, and F. M. Fryxell a committee for this purpose. The reports of the member societies will be fully discussed at the current AGI Directors' meeting.

The Association has been concerned with obtaining funds for the Journal of Geological Education. The new arrangement of dues allotments this year has helped. A gift of $100 from the Central Section in October was welcome and highly appreciated. However, a considerable backlog of unpublished articles exists. R. C. Stevenson, Executive Director of the AGI has offered assistance in making application to the National Science Foundation for a grant to defray the expense of publication of this material and, if possible, for financial aid on a continuing basis. Our Editor has submitted estimates for both current needs and annual deficits that may be incurred through the publication of a journal large enough to include all of the high quality manuscripts. It is too early to say how we shall fare on this proposal to NSF. Talks to date indicate a chance for funds to publish the present accumulation of manuscripts providing a proper plan is devised to meet our own publication problem in the future. The Executive Committee has drafted a proposal which I present to you at this time.

The members voted to change the name of the Association to the National Association of Geology Teachers by a three to one majority. The vote was based on returns from about 55 percent of the membership. It is apparently considered that the addition of the word National will give broader significance to the name of our organization.

The members also favored the erection of four new committees approved by the Executive Committee before the last annual meeting. The important and challenging task of appointing these committees prompted a desire for a careful study by the Executive Committee which could be made best at our meeting this morning when members were selected for the committees on Policy, Curriculum and Standards, and Finance. The Membership Committee will be named by the incoming Executive Committee.

Respectfully submitted,

CHILTON E. PROUTY, *President*

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# STUDENT REPORT WRITING MUST BE IMPROVED

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ABSTRACT. Upon graduation, most of our college students are inadequately prepared to communicate their geologic findings either by writing or by speaking.

Important facets of the problem are: (1) inadequate basic preparation in grammar and composition and (2) insufficient instruction in methods of writing scientific reports.

The first is a problem for the secondary schools rather than the colleges, and should be pushed back into their laps. The second is very much the problem of the college Department of Geology.

"The geologist is a scientist in every respect. His professional work after college will require him to do considerable written work, evaluating his decisions in words." John W. McCaslin was thus reminding us in his article, published in March, 1954, in the Oil and Gas Journal, of a very important facet of the geologists' professional work. Unfortunately, we geologists are not recognizing the true importance of this facet, or what is worse, we are giving it a mere nod rather than the attention that it really deserves.

As one whose written work has been criticized severely, as a teacher who has attempted to improve the student's awareness of his shortcomings in writing technical reports, and more recently as the director of a State Geological Survey which must edit these reports before publication, I have become acutely aware of the problem.

After writing the first draft of this paper last Spring, it occurred to me that perhaps the problem was not as difficult as I had thought, and that possibly several Departments of Geology had already solved it to their satisfaction. Accordingly, a letter was sent to 212 departments that grant Bachelor's degrees in geology. Of the 120 Departments of Geology that replied, although all require freshman grammar or composition, and most require one or more courses in literature, only 40 offer a course in the writing of scientific reports. Of those that do offer such a course, few require it for the Bachelor's degree; the number rises only slightly with the advanced degree.

In the few schools where the course in scientific writing is taught by the English Department, some of the Geology Departments are so dissatisfied with the course that it is not required for graduation. It seems to me that this assignment of the responsibility to the English Department can be satisfactory only if the English instructor is well versed in scientific writing; otherwise, the Geology instructor should be expected to contribute measurably to such a course. An alternative is a course taught by the Geology Department itself. This course

of action is likely to bear more fruit, although the English Department may rebel at the fancied invasion of its bailiwick.

Many conscientious instructors of field courses work over the report that the student turns in, and thus give him some of the training in writing that he needs so badly. But how few are these devoted instructors, who are willing to take the time (and it really takes a *lot* of time—far more than most instructors can afford) to do a thorough or even a merely adequate job?

Most of us teachers feel that we can sit idly by in our ivory (few of us can boast ivy) palaces while letting these rare stalwarts of the teaching profession overwork themselves into forced retirement five or ten years early, because of this devotion "above and beyond the call of duty." True, these few have earned the undying gratitude of their students whom they have thus helped, although this gratitude is rarely expressed until years after the students' graduation (because the value of what they are doing is not appreciated immediately).

For the rest of us teachers, then, the challenge is out. The geologic profession must work out a program whereby training in scientific writing is *required* of the geology major.

The course in scientific writing taught by the Geology Department, should include: reading several types of technical articles and examples of company reports, including poorly written, mediocre (most of ours), and well-written; writing several short papers or reports (1000-5000 words); and writing one long paper or report (10,000-25,000 words). The subject matter should be something familiar to the student, because in this course we are attempting to teach him to write, not to turn out an original piece of geologic research. The course should include detailed criticism of the papers by both the instructor and the student. Then the student should rewrite and resubmit his paper.

The student should not be eased too gently into being criticised. Rather, he should be deluged by *severe* criticism of the type that he will meet, say, when he turns in his thesis or his first company report. Perhaps all theses are not good examples, we will agree, because we all know of some that have been accepted with only perfunctory criticism because of (1) the great number of theses to be read, (2) the many other duties during the last month of the semester or quarter, or (3) the consulting jobs (let's be honest, now) from last year that must be written up by us before we can take on the outside jobs for the coming summer.

So, instead of criticism as for a thesis let us make this criticism as thorough and, yes, as shocking as when the poor, unsuspecting geologist sends his first paper to the Geological Society of America, the American Association of Petroleum Geologists, the Society of Mining Engineers of the A. I. M. E., or one of the other societies for publication in their journals.

Our job of editing should be much less when his thesis does come along if the student has participated in such a course in technical writing. The student, by now inured to the tortures of colored pencil marks on his writing, fondly (?) refers to

"*S*uggestions to *A*uthors" as "*S*ex *A*ppeal"; and sex appeal it gives, for it can help a drab report become an interesting one. With it, the geologist can be the parent of a youngster that he is proud to call his own—one whose well-molded body breathes the life of his geologic research, for all to see and admire.

The publication so irreverently referred to is of course the "Suggestions to Authors of *the* (my italics) Reports of the United States Geological Survey," which has just been completely revised and was published in June of this year. I recommend this excellent publication highly. With this book on his shelf, along with the American Geological Institute's "Glossary of Geology and Related Sciences," a good dictionary, a dictionary of synonyms, and Brown's "Composition of Scientific Words" or a similar root-book, the geologist's baby can be well-dressed. Additional garments will help, such as Fowler's "A Dictionary of Modern English Usage" (1940), and Rickard's "Technical Writing" (A. I. M. E.). A delightful costume is provided by Frank Calkins' "Punctuation and Cadence", which was distributed within the walls of the U. S. Geological Survey as early as 1951; unfortunately, it has not yet been published.

I am convinced, as director of one of the State Geological Surveys, that great saving in the handling of manuscripts would result if a course in scientific writing were required of all geologists during their student days. Editors of the geological journals will, I am sure, agree with this statement. With the greater number of manuscripts being submitted for publication, and the rising cost of publication, the problem of handling manuscripts is becoming more and more critical.

Let us make sure that we do our job of criticism properly. A story is told of the Geology professor—a dedicated man like those I have been describing—who, reading carefully a student's paper, made a check mark on page 2, noting "minus 5; look this word up." Reading on, he came to the same misuse of the word on page 7, and wrote on the margin "minus 10; I thought I told you to look this word up!"

Many respondents to my letter suggested more essay-type questions rather than the so-called "objective-type" examinations. I cannot jump on this bandwagon too hurriedly. I have used objective questions in my freshman classes because of the ease of grading large numbers of papers by myself, just as some of you have done; at schools where assistants grade the papers, essay questions are more difficult to grade exactly as the lecturer might have graded them. Nevertheless, even beginning students should be given less opportunity to parrot (or copy), and more opportunity to think. In advanced courses essay questions are a *must*, and the "objective-type" questions are a never—well, hardly ever (with a nod of course to Gilbert and Sullivan's "Pinafore").

But perhaps the most appalling suggestion of all is for improved scientific writing *by the professors!* This suggestion, given by more than one geologist, strikes too close to home to all of us teachers. It should remind us of the dentist who owns a mouth full of snaggle teeth and gaps, or of the preacher whose actions are not in keeping with his preaching, or of the geologist who has studied the

rocks of a mountain range 1000 miles away but has "never had the time" to look at the outcrops near his home. If the shoe fits, . . . It pinches, doesn't it?

Teachers, especially thesis supervisors, must first be taught. And for those of us who were not adequately taught we must learn so that we can teach. We should be able to cite examples from our own writing that will fall into each of the three categories—poor, mediocre, and good.

Thus the challenge is out. As a profession we geologists must insist that training in scientific writing be required of geology majors, first, so that they may enhance their positions in the companies for which they work; second, so that editors can better cope with their manuscripts; and third, so that the geologic literature will be full of readable and understandable papers.

## BOOK REVIEW

*Introduction to Historical Geology, 2nd edition.* R. C. Moore. ix and 656 pp. McGraw-Hill Book Co., Inc.; New York, 1958. $7.95.

Increasingly in geology courses the emphasis is being placed upon analysis and interpretation rather than description and memory. If a student is to realize why geology is a science, a historical geology text should tell him how we know that "the seas came in and the seas went out." The fascination of historical geology lies in tying it closely to the rocks and fossils from which it is interpreted. The second edition of R. C. Moore's text goes even farther in this regard than the first edition. It is larger by 74 pages, but there are many differences more important than increased size.

Inside the front cover is a table, "Geologic Distribution of Life Forms," on which the existence and relative abundance of 86 different groups of organisms are charted on the geologic time scale. Its value and attractiveness are enhanced by the inclusion of silhouettes of vertebrates representative of the groups charted. Inside the back cover is a simplified geologic map of Europe. Both are handsomely done.

The appendices have been expanded. "A", the characters of organisms represented among fossils, is a well illustrated discussion of the phylogenetic classification of animals and plants. It is better organized and much more comprehensive than in the first edition, and there are a few appropriate changes in detail to more modern classification. "B", a new appendix, is a table of lithologic symbols for geologic sections. It is useful information in any case, but is essential in this edition because standard and representative stratigraphic columns from different parts of the United States (and in a few cases, Europe) are given for each period, using the lithologic symbols. The use of the realistic symbols, and the many sections, add greatly in relating the account of geologic history to the rocks. Appendix "C", also new, is a comprehensive and useful glossary.

In the text itself the format is changed. The pages are larger, each has two columns of text, and most of the illustrations held over from the first edition are enlarged, which makes them more striking. Among the many new illustrations are a number of highly realistic pictures of prehistoric animals, by J. Augusta and Z. Burian. For each period there is a map showing in considerable detail where its rocks outcrop, where they are inferred to lie subsurface, and where they are inferred to be absent subsurface, as well as areas where older rocks are exposed. Oddly enough, the maps also show the location of all colleges and universities teaching historical geology. The text is more closely tied to the illustrations, by means of references to figures; a convenience lacking in the first edition. General principles are well illustrated with specific examples described in detail. As in the first edition, all chapters on periods have

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# THE WRITTEN WORD

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ABSTRACT. While there is need for improvement in the training given in many elementary and high schools, the college teacher should accept responsibility for developing abilities in communication in the students who appear in his classes. This probably can best be done in connection with the writing of term papers and of field trip and field course reports. A special course in communication is recommended, even at the expense of limiting subject-matter coverage in the curriculum. Graduate students should be given teaching experience, to improve their skills in organizing and presenting material and to develop self-confidence.

In writing for publication, a manuscript should be prepared which conforms to the style of the journal to which it is submitted. The preparation of a complete manuscript is a part of the author's task of communication.

It is common practice these days to castigate the grammar schools and high schools for failing to train their students in the fundamentals of reading, writing, and arithmetic. The college teacher should, however, accept responsibility for providing training in communication for the students who appear in his classes. The average student probably is much more susceptible to learning how to communicate when he is interested in the subject matter being communicated.

Many teachers of third-and fourth-year college courses blame the students' limited writing ability on the use of too many true-and-false and multiple-choice examination questions in the elementary courses. They believe that if more essay questions were used, the students would develop greater facility in writing. I suggest that the writing of material which must be judged primarily for factual content, under the stress of examination conditions, is not conducive to the development of writing skill.

I believe that the writing of term papers and of field trip and field course reports is a much more valuable experience, if the teacher evaluates the writing along with the factual material and if the student is required to revise his writing and to re-submit the papers.

In many departments of geology the curriculum already has been revised to place more emphasis on training in chemistry, physics, and mathematics, and coverage of the subject matter of geology has been reduced. I think that we should recognize the need for training in communication and should provide it, even if a further reduction in subject matter coverage is necessary.

In our regular courses we certainly should pay more attention to the development of speaking and writing ability. We should see that students who are particularly deficient in these abilities get special help. In addition, it may be desirable to give a course in communication—not just for the most deficient students, but for the better ones as well.

It has been my experience at both the University of Chicago and the University of Illinois that most of the questions asked in Master's and Doctor's examinations involve very elementary principles and a minimum of knowledge of geology; that a large part of the examination time is spent in painfully extracting the fundamental material. This appears to be due to the student's limited ability to express himself, and to a lack of confidence in himself. In general, the students who perform well in the examinations for degrees are those who have served as teaching assistants. Many of the presumably more brilliant students, who have gone through graduate school on fellowships and have excellent grades, but who have not had any teaching experience, do poorly in their examinations for the degrees. Teaching experience is experience in organization and communication, and it may be an aid in developing self-confidence. It should be helpful in developing writing ability as well as speaking ability.

Someone, probably Cary Croneis, once said that if a seemingly complicated, highly technical-sounding statement were re-written in simple English with a minimum of technical terms, the author would probably find that a very small and not very original thought had been expressed. No scientifically trained reader should object to a clear presentation in simple language, and such a mode of expression certainly will be appreciated by the non-specialist.

It is not necessary to discuss, here, the details of good writing.—The publication, "Sugestions to Authors of the Reports of the United States Geological Survey" is an admirable guide. Both students and professional geologists should make use of it.

A particular thought which I wish to emphasize is that the preparation of a complete manuscript is part of the author's job of communication. Typing of the manuscript and inking of the illustrations may properly be delegated to specialists in those fields—but completion of the manuscript in a form suitable for publication in a particular journal is not a task that should be passed on to an editor.

A survey of seven American geological journals has shown that the number of pages printed per year has increased from about 5500 in the year 1945 to about 8800 in the year 1957. The average increase is 40 printed pages per journal per year. During this same period, most of the journals have increased the number of words carried on each page. Because of these increases, there is a great deal of additional work for the editors. Several of the journals are edited by volunteers working on a part-time basis, who have part-time, temporary assistants. It is especially in view of this that I believe that the preparation of a good manuscript is an essential part of the author's job of communication. The following advice is offered:

1. The manuscript should be written for the particular journal to which it will be submitted. This requires that the author examine recent issues of that journal, and any style sheet or statement of rules and suggestions of that journal, before he begins to write. Most of the mechanical details such as order of headings, capitalization, abbreviation, and manner of citation of references can then be put in proper form while the paper is being written.

2. Particular attention should be paid to the form in which references are listed in the bibliography; to their capitalization, abbreviation, order of items, and completeness.

3. When a final draft of the manuscript is completed, it should be laid aside for a brief period, then should be read again. It is generally desirable to have someone else read the manuscript and offer suggestions for its improvement.

4. The preparation of *illustrations* is a field in which many authors are deficient. It has been said that "one illustration is worth a thousand words"; but this can be true only if the illustration is pertinent and is well-planned.

Maps, graphs, and other line-drawings should contain a minimum of detail. They should be planned to fit within the page dimensions of the particular journal they are submitted to. The lettering on line drawings should be large enough to permit a maximum amount of reduction. Figures should be numbered in the order in which they are referred to in the text.

Many other common specific deficiencies of manuscripts and of illustrations could be enumerated here. Most of them could be avoided, however, if the author would assume that completion of the manuscript is part of the process of communication, and would make the slight effort required to insure that his manuscript conformed to the usage of the particular journal he sends it to.

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# PROBLEMS IN GEOLOGIC EDUCATION
# THE ELEMENTARY COURSE

ARTHUR F. HAGNER and DONALD M. HENDERSON
*University of Illinois*

ABSTRACT. In August 1958 the Geology Department of the University of Illinois completed its second Summer Institute sponsored by the National Science Foundation. Since further institutes are not planned by the authors, we take this opportunity to sum up the interactions of 82 participants, visiting lecturers, and staff members to problems of geologic education.

Many problems stem from the fact that geology is both a derivative and a natural science in its own right. To handle it requires the ability to think in terms of several variables at once, to recognize problems and ways of dealing with them, and to appreciate the development and significance of hypotheses and the evidence upon which each rests. This calls for the use of judgment. To contribute to the advancement of geologic knowledge requires, in addition, creative ability.

The nature of our science poses problems of student and teacher preparation. Problems imposed by society and our educational system have to do with enrollment and the diverse educational aims of the various colleges and universities.

It was agreed that teachers should stimulate and guide the student in his own development, help him think and write critically and creatively, recognize problems and approaches to them, and appreciate the importance of facts and reasoning from facts. This can be accomplished by conceptual rather than merely informational instruction, by class discussions and reports, and by early research by capable students. The need to attract more of the better science students, and for a strong foundation in fundamental sciences was recognized.

During the past two summers the Geology Department of the University of Illinois conducted Summer Institutes in Geology for College Teachers sponsored by the National Science Foundation. A great deal of informal discussion centered around the problems of the elementary geology course and we here summarize the interactions of the eighty-two Institute geologists to these problems. Although the following remarks reflect the views of many geologists, we especially thank Drs. Robert Garrels, Conrad Krauskopf, Gordon MacDonald, George DeVore, and James Thompson for their interest and their excellent ideas and suggestions.

The elementary course is taught both for geology majors and to meet the science requirement. In most beginning courses the great majority of students are non-professional. Their science backgrounds are varied, and consequently the course is usually taught as though the student had no chemistry, physics, or biology. However, many teachers thought that attempts to teach physics and chemistry in beginning geology courses take up much time that should be devoted to geology. Others, however, believed it advisable to teach certain elementary principles of chemistry and physics where they were applicable to the geologic principles under consideration.

Geology is not entirely a derivative science built upon physics, chemistry, and biology. It is also a natural science in its own right whose development requires special abilities and background. The student should be able to juggle several hypotheses and variables at one time, and select the most likely one.

The student should realize that much of science is tentative, and that the geologist is trying to get an approach to the truth. The scientist's method is fairly simple. He starts with an idea and then goes about testing, altering, and refining it. The resulting hypothesis may approach reality but all too frequently we cannot be certain of it.

It was the opinion of the group that most of our teaching is excessively descriptive and expository, with emphasis on rote learning to the detriment of independent analysis and reflection.

Many of the teachers thought the elementary geology course achieves broad coverage at the expense of depth. It is customary to present the latest, generally accepted ideas and attempt to be as all-inclusive as possible. Little opportunity is given for critical and creative thought on the part of teacher and student.

The understanding of a subject is much more than the assimilation of facts and data. Unless facts and observations are arranged in some pattern so that they can be related, correlated, and generalized in a system of thought, understanding, is impossible. It is common practice for the teacher to do this entirely for the student. But the student should have experience in constructing his own system or model, no matter how naive it may be, otherwise it does not become a part of his mental processes, and insight does not result. It was thought that this should be done in the laboratory. The study should go beyond the solution of a simple problem, it should consider its relation to broader concepts, and should elicit suggestions regarding its generality and possible further research. Vocabulary, facts, and techniques, must be learned but they should not be goals or ends in themselves; they should be used in solving problems and in developing and understanding geologic concepts.

In college, teaching should be provocative and conceptual. Student's are stimulated and challenged more by ideas, problems, and concepts than by descriptions, explanations, and memorization of unrelated facts. We should emphasize geology as the science rather than the descriptive aspects. We can accomplish much by continually confronting the student with questions and ideas and by getting him to contribute ideas of his own. Emphasis should be on interpretation and integration. "What are the worthwhile questions and problems in geology?" "How do we go about setting up hypotheses and testing them?" "What is their value in guiding and delimiting inquiry?" "What does it take to prove a hypothesis?" "What are the bases of, and evidence for, a hypothesis and the reasons it is preferable to another?" And here we should not be too dogmatic about our own preferences. "In what way can and does inquiry go astray?" The students should thus take an active and not merely passive part in their own education.

Many of the teachers were concerned about the specific concepts that should be taught in the elementary course. Just what to cover must be the decision of

each individual teacher, and here, of course, there were differences of opinion. A successful teacher knows what the student must learn and is quite determined that the essentials will be thoroughly mastered.

There are, nevertheless, several major concepts the beginning student should master upon which there was general agreement. These include the following:

1. The earth is very old.
2. The present furnishes a key to understanding the past.
3. There is a progressive biological change through time and it follows a fairly definite pattern.
4. There is a pulsating physical change through time which changes land to sea and vice versa, resulting in periods of deposition and periods of erosion which mark the boundaries of the geologic time-scale.
5. Serial relationships of rocks suggest that they are of a common origin.
6. The earth as a whole does not behave like a small piece of rock. It is a body responsive to the gravitational attraction of the moon and to plastic deformation.

In addition to understanding these broad concepts, the beginning student should be able to: read geologic history from rocks; see things in a fourth dimension, namely time; recognize the common minerals and rocks; understand something of their genesis; recognize the major phyla; have an understanding of ecologic behavior; gain an appreciation of scale theory and its importance in geology; and know the criteria of earth age.

There was a sharp difference of opinion over when in the student's career mathematics, chemistry, and physics should be taken and how extensive their study should be. A few thought that two years of these subjects should be required before the student takes the beginning course in geology. Students with such a background have a great advantage over those without it and this small group will have a relatively large influence on the future of geology. However, most of the teachers thought that this scheme was not good pedagogy because it assumes that one enters geology logically through mathematics, chemistry, and physics. Generally, however, the student becomes interested in a problem and then "digs into it" and acquires the necessary background. He should become aware of the problems early in his career by taking geology early and throughout his schooling. The background courses should be taken along with geology and used in geology.

Perhaps the most pressing practical difficulty is posed by the large size of many beginning classes. However, it is customary to divide large classes into much smaller sections for laboratory and discussion and it is in these sections that the student should be encouraged to engage in independent thought. Interchange of thought by student and teacher tends to be infectious and, if conducted properly, to lead to deeper and more original thinking—in other words, eventually to research and the advancement of knowledge.

The reason usually given for avoiding depth in teaching is that there is not sufficient time for thorough analysis and imaginative thought. Some believed this to be an unsurmountable difficulty, but many thought that a careful selection and concentration upon a few concepts was preferable to "complete" coverage, and that it also helped to motivate the student and provided a desire for further creative study.

Another difficulty is that geology is not getting its share of the best students. It was thought that this was due to two reasons: (1) the absence of geology in the great majority of high school curricula, (2) the usual method of presentation does not attract the best students.

The group agreed that teachers should: (1) make more effort to stimulate students to think critically and clearly, (2) help them to develop and use whatever creative abilities they possess, (3) emphasize problems in geology and the approaches being made to solve them, (4) encourage the interested and gifted student to engage in research as soon as possible, and (5) conduct more discussion sessions and fewer formal lectures.

It was the general opinion of the teachers that the elementary course, regardless of sudent backgrounds, should not be watered down. It should be one in geologic reasoning and imaginative thought dealing with concepts, and pitched at the highest possible level coincident with the students' backgrounds.

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## SUMMARY REPORT OF THE TREASURER

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| Cash balance on hand, 1/24/58 | $ 928.43 | | |
| Cash received, period 1/24/58-1/15/59 | 1,687.75 | | |
| Total cash received, period 1/24/58-1/15/59 | | 2,616.18 | |
| Expenditures, period 1/24/58-1/15/59 | | 1,429.72 | |
| Cash balance on hand, 1/15/59 | | | 1,186.46 |
| Horberg Fund Savings Bonds | | | 325.50 |
| Total, cash and bonds on hand, 1/15/59 | | | $ 1,511.96 |

Respectfully submitted,

J. C. BRICE, *Treasurer*

# BOOK REVIEWS

*Elements of Geology.* J. S. Zumberge. viii + 382 pp. Wiley and Sons, Inc. New York. $5.50.

"The human mind is not satisfied with observing and studying any natural occurrence alone, but takes pleasure in connecting every natural fact with what has gone before it and with what is to come after it." This quotation from John Tyndall at the bginning of Chapter Five characterizes nearly every section of this text. The chapter on earthquakes furnishes an illustration of the author's apparent plan to follow the quotation in the organization of his material. Factual information is presented first. The theories brought out and the scientific speculation relative to the unknown interior and future quakes continue ideas from Tyndall. Deductions, concepts and surmises are presented in such a way as to challenge and please the reader.

Zumberge anticipates sharp criticism from some geologists for writing, without help, a physical and historical geology. He does credit specialists among his colleagues at the University of Michigan for assistance in some areas. But your reviewer is of the opinion that not a few teachers will appreciate his courage in undertaking and completing a thoroughly well organized text with consistant vocabulary and single outline.

*Elements of Geology* is slightly misleading as a title of a text containing dynamic and historical teaching material. However, it is not seriously so because most elementary texts contain some historical introductory facts, regardless of title. The author recommends that the text be used in one-semester courses. It would be a fine text for those who have selected careers in other fields but who have need for some knowledge of geology.

Teachers may criticize the omission of some desirable items, for example, lists of maps, tables and pictures. Zumberge has selected photographs of excellence. Bell and Coates have made pen drawings that are certain to be of great pedagogical value. There is at least one table in each chapter. But the only way these can be found is to look through the text. All illustrations are helpful to students, so your reviewer would consider having a single place where they are listed, essential.

*Elements of Geology* seems certain to be considered one of the best texts for a one-semester course in which basic geologic principles are to be introduced. It is part of the answer of the earth-scientists to the "general education" enthusiasts. The book presents an overview of fundamentals of geoscience in a scholarly manner that recognizes its readers' background for technical understanding is in other disciplines.

V. CALVON McKIM
*Fresno State College*

*The Fossil Book.* Carroll Lane Fenton and Mildred Adams Fenton. xiv and 482 pp., 8 color plates and numerous drawings and photographs. Doubleday and Company, Inc. Garden City, New York. 1958. $12.50.

Here is a remarkable book, combining readability and lucidity of explanation with up-to-date information and thoroughness. No longer need one grope for an answer when asked to suggest a good book for a budding amateur paleontologist, who might find a college textbook a bit formidable, but some popular books too limited in scope. The Fentons have provided the answer with their magnificently illustrated and interestingly written "The Fossil Book." This should be no surprise to those familiar with their "The Rock Book." Not intended as a textbook, The Fossil Book still covers the field of paleontology from the simplest, one-celled forms of life to the most highly developed plants and animals (stopping short of Man); and traces life development from its Pre-Cambrian beginnings up through the Pleistocene. In addition, it presents some of the challenging problems of paleontology.

The book opens with a discussion of various methods of fossilization, where to look for fossils, and how they offer clues to past environments. It then introduces certain principles of historical geology and stratigraphy, and presents a geologic time scale which spreads across two adjacent pages. Methods of dating rocks are discussed. The biologic

approach follows, with a discussion of classification and nomenclature. While there may not be universal agreement with the Fentons' classification of both Monerans and Protists in separate Kingdoms of equal rank with Plants and Animals, their explanation justifies their point of view. Also, as in many of their other discussions of terminology and classification, important background or historical information is provided.

After the presentation of family trees for both plants and animals, the geologic approach is followed in a resumé of the Pre-Cambrian fossil record. From this point on, the book follows an intermediate course, generally based on increasing complexity of phyla, but also emphasizing geological sequence.

Coverage of each of the phyla is general, descriptive, and good, but not detailed. Genera are described by salient characteristics, but not always enough to be diagnostic. There are, however, hundreds of detailed drawings and photographs, accompanied by generic and specific names, which will surely find frequent use for identification purposes by many owners of the book. Geologic range is given in general terms, only.

Fascinating as the story is, interestingly as it is written, and clearly as it is illustrated, there is some difficult reading. With this in mind, the authors have added a seven page glossary at the end of the book, and the index gives the pronunciation of the more complicated fossil names. Other aids to the amateur are directions for collecting, cleaning, preparing and labeling fossils, and the lists of helpful publications and of outstanding museums.

There are a few typographical errors, but these are of minor importance as compared with the fine job the authors and the publishers have done in putting together an informative and attractive book which will have a wide appeal in the field of popular geology.

KATHERINE GREACEN NELSON
*University of Wisconsin—Milwaukee*

*Continued from page 32*

similar systematic organization. This helps the student organize and digest the material, and find specific information about a given period. The chapter on the Precambrian is expanded considerably, and the revised time-stratigraphic column for the Canadian Shield is used.

The account of the mode of evolution is short, with only the briefest mention of Lamarck, and almost nothing on Mendelian laws, mutations, and the mechanisms of heredity—which, after all, accounts for variation of individuals within a species. Moore feels it is not appropriate to review studies in genetics, but this is as fundamental to understanding of changing forms of life in geologic history, as an understanding of atoms is to the study of minerals.

In the book there is a commendable trend toward introduction of modern geologic nomenclature. There is no point in avoiding technical nomenclature in a scientific field where it may provide a single name for a valid concept or recognized process about which the student should be aware. Thus, "craton" is introduced, and should be italicized where it is defined. On the same page (p. 67), however, there is mention of "subordinate cratons" of which the reviewer infers an example might be the Ozark dome. This seems to be a perversion of Stille's concept. In this edition Moore embraces the island arc idea of borderlands, and describes Paleozoic geosynclines marginal to North America, including their sediments. Having gone this far, one might just as well tack on the names and define "eugeosynclines" and "miogeosynclines."

On page 272, in the chapter on the Permian, is repeated an error which appears in the first edition. Citing evidence of volcanism associated with sedimentary rocks, the statement is made that this evidence is noteworthy inasmuch as Paleozoic rocks older than Permian in western United States are not associated with volcanic rocks. References to many instances of volcanic rocks older than Permian, in western United States, are cited in Kay's "North American Geosynclines," pp. 35-42.

To be able to write a textbook without any errors would be divine, especially a text as crammed with information as this one is. Compared to the value of what is right about this book, the errors are minor indeed. The second edition is much better than the first, and the first was very good.

DAVID HAWLEY
*Hamilton College*

# TRANSACTIONS

# OF THE

# NATIONAL ASSOCIATION OF GEOLOGY TEACHERS

## MINUTES OF THE EXECUTIVE COMMITTEE MEETINGS HELD IN ST. LOUIS, MISSOURI ON NOVEMBER 7, 1958.

*Present* Prouty, Heald Foote, Brice, Marple, Berg, Dyson, Ryan, Gutschick. The Central Section was represented by proxy. The President-elect and the Treasurer-elect also attended the meeting.

The meeting was called to order at 9:20 A.M. President Prouty first brought up the problem of the exact amount of the dues that unaffiliated members should be charged. There has been some confusion whether this should be $2.50 or $3.00 The committee unanimously adopted the following motion made by Prouty, "The dues of the Association shall be $3.00 of which fifty cents shall be payable to any section with which a member may be affiliated."

The method of nominating and electing officers of the Association then came up for discussion. The committee unanimously approved the proposition that the following amendment to the Constitution be submitted to the membership, "that *Article V, Section 6(a)* be amended to read 'Officers of the Association, with the exception of the Editor, shall be elected annually by mail ballot from one nomination for each office with write-in privilege for each office, submitted to the members at least 30 days before the announced Annual Meeting of the Association'."

The problem of providing continuity in the conduct of the affairs of the Association was next discussed. Heald moved that the Executive Committee encourage the Nominating Committee to consider the re-election of the Secretary and the Treasurer for as many years as possible. The motion was passed.

Heald then moved that *Article V, Section 6(c)* of the Constitution be amended by adding at the end of the first sentence ", and the chairman of the Nominating from the previous year." The motion was unanimously passed.

Foote moved that a notice be carried in the *Transactions* reminding members that the Nominating Committee would be glad to receive suggestions for officers from the membership as a whole. This motion was passed.

The Executive Committee then proceeded to appoint members to the new committees that the Association had voted. The following men were appointed to the *Policy Committee*: Behre, Berg, Dorf, Fryxell, Howland, Peoples, Foote (one year), and Prouty (one year). This committee is to select its own chairman.

Prouty was appointed chairman of the new *Curriculum Committee* and the other members are Behre, C. D Campbell, Lester, Shrock, Duncan Stewart, and Webb.

The following men were appointed to the *Finance Committee*: Lowe, chairman, Brice, R. W. Edmund, J. O. Fuller, and Higgins.

Foote asked for a clarification on the Association's policy of furnishing stationery to the sections. The committee voted that the National Secretary maintain a supply of paper, envelopes, and membership cards on which would be printed only the name of the National Association and that these be made available to the sections without charge.

Pouty announced that Dyson would serve for another year as AAAS Representative and that Berg would continue for a second year as AGI Representative. S. P Ellison was appointed the second AGI Representative for a two-year term. A. O. Woodford was designated the hold-over member of the Neil Miner Award Committee.

The President announced that Mrs. Marple had submitted her resignation as Editor effective after the 1959 Spring *Journal of Geological Education* had been published. Her resignation was accepted with regret.

There being no further business, the meeting adjourned at 12:20 P.M.

## MINUTES OF THE BUSINESS SESSION EIGHTH ANNUAL MEETING, NOVEMBER 7, 1958.

The meeting, held at the Sheraton-Jefferson Hotel, St. Louis, Missouri, was called to order

by President Prouty at 1:30 P.M. The reading of the minutes of the Seventh Annual Meeting was dispensed with since they had already been published in the Transactions printed in Vol. 6, No. 1 of the Journal of Geological Education.

The reports of the President, Secretary, and Treasurer, which are appended, were heard. President Prouty announced a gift from the Central Section of $100 to the National Association and expressed the appreciation of the Executive Committee. He then told of the action taken by the Executive Committee to clarify the amount of the dues for members not affiliated with any section.

The President reported the results of the mail ballot on five proposed amendments: 171 members voted in favor of changing the name of the organization, 64 disapproved, and 8 abstained from voting; 173 were in favor of setting up a Policy Committee, 58 against, and 12 abstained. The Curriculum and Standards Committee was approved by 191 members, while 40 voted against it and 12 abstained. Two hundred and twenty-three voted in favor of the Finance Committee, while 15 disapproved and 5 abstained. The Membership Committee was approved, 219 voting in favor, 18 against, and 6 abstaining. Since more than the required third had voted, the amendments were declared in force.

The President then announced the appointment by the Executive Committee of S. P. Ellison as AGI Representative and A. O. Woodford as the hold-over member of the Neil Miner Award Committee. He also reported that the Executive Committee had approved the submission to the members of two new constitutional amendments.

In the absence of the Chairman of the Nominating Committee, the Secretary read the results of the election of officers for 1959. They are: President, Robert R. Shrock, M. I. T.; Vice-President, Robert L. Nichols, Tufts College; Secretary, Freeman Foote, Williams College; Treasurer, Sheldon Judson, Princeton University.

The President then called for nominations from the floor for two members-at-large for the Neil Miner Award Committee. The names of Erling Dorf and Charles H. Behre, Jr. were proposed. There being no further nominations, the nominations were closed and the Secretary was instructed to cast one ballot for the slate as constituted.

President Prouty then presented the 1958 Neil Miner Award to Charles H. Behre, Jr. whose acceptance speech will be published in the Journal of Geological Education.

C. D. Holmes, speaking for himself and G. T. Wickwire, said that they both were disturbed over the state of geologic terminology. They had observed that there were a number of geologic terms that had two or even three meanings and that there were other terms whose meanings were in doubt. He urged that NAGT establish a committee to study this problem. As the announced hour for the symposium on "Communication in Geology" had arrived, it was moved that the discussion of Professor Holmes' problems be held after the symposium was over. When the Business Meeting was reopened, several members felt that the problem of geologic terminology was one that properly belonged to AGI. Kurt Lowe made the following motion which was seconded by M. T. Heald: "It is the consensus of the Annual Meeting of the National Association of Geology Teachers that we urge the Executive Committee of the American Geological Institute to use its good offices to transmit to its member societies the urgent recommendation to set up commissions on geologic nomenclature for the purpose of simplifying and clarifying nomenclature in their several disciplines using the card index of the AGI Glossary as a point of departure." The motion was passed.

There being no further business, the meeting adjourned at 5:23 P.M.

Both the Business Meeting and the Symposium were well attended. There were over 100 in the room when the Business Meeting was called to order. The attendance throughout the Symposium averaged 175 and 112 members were present when the recessed Business Meeting adjourned.

## RESULTS OF THE MAIL BALLOT OF NOVEMBER 22, 1958.

On November 22, 1958 two proposed amendments to the Constitution were mailed to the members for adoption. The deadline for returning ballots was set at December 22, 1958.

The first amendment calling for only one nomination for each of the national offices

was adopted, 223 voting in favor, 11 against, and 2 abstaining.

The second amendment adding the chairman of the previous year's Nominating Committee to the current committee was also accepted with 234 voting in favor, 2 against, and no one abstaining. Two hundred and thirty-six members returned their ballots out of a total of 461 declared eligible to vote. Since more than the required one third voted, the new amendments are now in force.

## REPORT OF THE SECRETARY

The membership of the Association now stands at 599. Unfortunately this figure includes 131 persons who have not paid their current dues and are, therefore, not receiving the Journal of Geological Education.

In the Spring the Executive Committee was polled by the Secretary on a proposition of the American Geological Institute to change the wording of the Association bills so that the AGI could avail itself of second class mailing privileges. The proposition was approved by the Executive Committee 12 to 0.

This year the Nominating Committee, of which Dean E. F. Cook was the chairman, began its correspondence in March. It was the first Nominating Committee in three years to produce a full slate of officers with two candidates for each position. They deserve our congratulations but the perennial question, "Do we really wish to nominate two names for each office?", still remains.

The secretary wishes to apologize for the late mailing of the ballots and to state that this was in no way the fault of the Nominating Committee whose complete list of nominees was received September 20th. The difficulty arose from your Secretary's inability to forsee the time that can be consumed in having envelopes printed in one town, addressed in another city a thousand miles away and then returned to be stuffed and mailed in the original town.

Respectfully submitted.

FREEMAN FOOTE, *Secretary*

## PRESIDENTIAL ADDRESS

In the present period of rapidly changing conditions in the colleges brought about by the emphasis on science, it is more important than ever that we take stock of the status of our Association. If, indeed, we have an important role to play, we must define this role and go at it soon.

Certainly the Association has travelled a long way from its informal beginning in the midwest twenty years ago when a handful of men gathered to exchange slides. It might be fairly judged that the Association is now in a position to pass rapidly from the late youthful to the early mature stage of our development.

First we should reflect on just what we are attempting to do. According to our constitution set up in 1951, we should "foster improvement in the teaching of the earth sciences at all levels of formal and informal instruction, emphasize the cultural significance of earth sciences, and disseminate knowledge in this field to the general public." These are admirable goals. But many, I feel sure, would contend that there are more important problems facing us today that need more emphasis than the cultural significance of geology. The word "geology" is fast becoming a part of even the grade school pupils' vocabulary. This is good and we are all glad to see it. Geology is beginning to sell itself.

I wonder then if we should not be more interested in the quality of our geology students and graduate students than in their numbers. The quality of the student depends on better screening of the potential majors. The quality of the product depends on the instruction and the curriculum. Concepts of science and technology and industry are changing rapidly. To meet the challenge we need to give very serious thought to our manpower needs, the detailed analysis of our curricula both in geology and collateral courses, to academic standards for students entering the profession, and possibly to the matter of licensing.

Does our Association have the tools to meet the challenge at this time? I believe the answer to this will depend in large measure on the emphasis and conscientious endeavor shown in the newly activated committees which have been set up by the Association.

The Policy Committee has been set up to define our underlying philosophy and our long-range goals. The committe is of prime importance to the Association and is composed of men who have had long experience in

teaching and administration. To insure continuity of policy this group has been set up as a permanent committee and each year the retiring National President and Secretary will become members of the committee to provide close contact with the operations of the Association for the year. The group has been given as broad regional representation as was commensurate with the individual qualifications needed for the committee members. This committee will have close liaison with all other committees of the Association and with the Executive committee for each year.

The Curriculum and Standards Committee is also a permanent group. The members were selected by the Executive Committee on the occasion of the Annual Meeting in Saint Louis in November, 1958. Each Section is represented and an effort was made, where possible, to select men who are at present or have in the past served as chairmen of Geology Departments. This committee has several important responsibilities. First, it will make a thorough study of the geology offerings in universities and colleges and devise a curriculum which, to the committee, appears most compatible with the current and projected needs of industry. They will also consider curricula which will adequately prepare students for graduate study. Implicit in the area of operation of this committee will be the matter of accreditation, but there should be a close liaison with the American Geological Institute which is presently active in this study. The committee must decide to what extent, if any, the registration and licensing of geologists and geophysicists should come under its purview. This committee should take the initiative in curriculum and standards studies and offer any help in these areas that may benefit the profession.

The Finance Committee was established as a standing committee. It will be concerned with current and long-range financial policy, working closely with the Membership Committee in the matter of current financing. The Exectuive Committee has already considered this problem and its findings will be turned over to the Finance Committee for further analysis. The Finance Committee also has the problem of examining carefully the possibility of establishing a permanent office for the Association with a permanent secretary. This of course is a big step but would mean much to our efficiency of operation and continuity of purpose from year to year.

The Membership Committee was organized on an annual basis. Our membership is but a fraction of the potential among geology teachers. Also, there are many, other than teachers, who under our membership rules would represent "such other interested persons as are engaged in disseminating geological information." Since 70 percent of all geologists are employed in industry it is possible that we should extend our membership to employers who have such a direct interest in the product being turned out by the universities.

In summary, it would appear that we do have the potentiality and the necessary structural set-up to increase rather rapidly the effectiveness of our Association. With close liaison between our committees, with more frequent and longer meetings of our Executive Committee, with greater power vested in the Executive Committee to permit faster and more flexible action, and with the continuation of the high quality of the programs in the Sections as well as in the National meetings, we may well be on our way toward the achievement of our goals.

CHILTON E. PROUTY, *President*

*The report of the president will be found on page 28.*

# CONSTITUTION

## of the

# NATIONAL ASSOCIATION OF GEOLOGY TEACHERS

As amended April 1, 1953, March 28, 1955, October 28, 1958, and December 22, 1958.

### Article I—NAME

The name of this organization shall be *National Association of Geology Teachers,* hereinafter referred to as the Association.

### Article II—PURPOSES

The purpose of this Association shall be to foster improvement in the teaching of the earth sciences at all levels of formal and informal instruction, to emphasize the cultural significance of the earth sciences, and to disseminate knowledge in this field to the general public.

### Article III—ORGANIZATION

Section 1. National Association.

The Association shall be organized as a *National Association* with Association officers, publications, dues and meetings.

Section 2. Sectional Units.

Regional *Sections* of the Association may be organized by the Association membership in various parts of the country. Such *Sections* will function under this Constitution, but may have their own Section officers, publications, dues, meetings and By-Laws, provided that such By-Laws do not conflict with the provisions of this Constitution.

### Article IV—MEMBERS

Section 1. *Active Members* of the Association shall be those who are or have been engaged in some aspect of teaching of the earth sciences and shall also include such other interested persons as are engaged in disseminating geologic information.

Section 2. *Honorary Members* shall be distinguished individuals whom the Association may wish to honor and shall have all the rights and privileges of active members, but shall not be required to pay dues. They may be elected by unanimous vote of the Executive Committee of the Association.

Section 3. *Membership* may be granted by the Executive Committee of the Association or of any organized Section to persons whose qualifications are submitted and who are sponsored by a member of the Association. Membership in an organized *Section* shall constitute membership in the *Association.*

### Article V—OFFICERS AND DUTIES

The officers of the Association shall be President, Vice-President, Secretary, Treasurer, and Editor.

Section 1. The *President* shall be the chief executive officer of Association and shall preside at all meetings of the Association and of the Executive Committee. He shall attest all official records of Association.

Section 2. The *Vice-President* shall serve in the place of the President, if the President is unable to perform his duties. He shall also be ex officio member of all Committees and shall be responsible for arrangements for the Annual Meeting of the Association.

Section 3. The *Secretary* shall keep the official records, shall attend to the correspondence of the Association, and shall keep the membership informed on Association affairs by distributing Transactions at least once a year.

Section 4. The *Treasurer* shall collect and disburse Associaton funds under appropriate authorization.

Section 5. The *Editor* shall be Chairman of the *Editorial Board* of the *Association* and, as such, shall be responsible for all formal publications sponsored by the Association, except the *Transactions*. The Editorial Board shall consist of the Editor, the various Section Editors, and the Treasurer of the Association.

Section 6. Election of Officers.

a. Officers of the Association, with the exception of the Editor, shall be elected annually by mail ballot from one nomination for each office with write-in privilege for each office, submitted to the members at least 30 days before the announced Annual Meeting of the Association. The Editor shall be appointed by the Executive Committee. Elected officers will serve from the close of the Annual Meeting at which their election is announced to the close of the next Annual Meeting. The Editor's term of appointment will normally be 3 years and shall start at the close of the Annual Meeting at which the selection is announced.

b. The President and Vice-President may not succeed themselves.

c. The Nominating Committee shall consist of one member from each organized *Section*, elected at the annual meeting of each Section, and the chairman of the Nominating Committee from the previous year. The chairmanship of this Committee shall rotate among the Sections in order of seniority.

## ARTICLE VI—COMMITTEES

Section 1. The elected officers of the *Association*, the last past-president of the Association, the president of each organized Section of the Association, and the Association representatives to the American Geological Institute and the American Association for the Advancement of Science, shall constitute an *Executive Committee* with authority to expend funds and take action in behalf of the Association membership, provided that all official acts of the Executive Committee are reported to the Association membership at the Annual Meeting following such action, and provided that no financial obligations are incurred which exceed the collectable resources of the Association for the period for which the members of the Executive Committee have been elected.

Section 2. *Policy Committee*—A permanent steering committee selected from the membership at large and composed of teachers of 20 or more years of teaching experience. The Committee shall select its own chairman. Each year the retiring National Chairman and National Secretary shall serve for a one year term. Vacancies by death or illness shall be filled by appointment by the active Executive Comittee of N.A.G.T. This Committee shall have as its primary function the statement of the underlying philosophy of N.A.G.T., is scope and its service to the profession. It will also act as a "Hearing Committee" on matters of the violation of professional ethics.

Section 3. *Curriculum and Standards Committee*—Selected by the Executive Committee now in office. This shall be a permanent committee, each section represented, selected preferably from those members who are acting or have acted as departmental chairman. Vacancies filled as in Section 2 above.

Section 4. *Finance Committee*—shall be elected from the membership at large. Selections shall be made by the present Executive Committee of N.A.G.T. The chairman shall be designated at the time of the appointment.

This committee shall establish the financial policy of N.A.G.T. and examine carefully the possibility of establishing a permanent office for N.A.G.T. with a permanent Executive Secretary.

Section 5. *Membership Committee*—An annual Committee serving for a one year term. It shall be selected by the Executive Committee as early in the term of the Executive Committee

as possible. The membership of this committee shall be composed predominantly of the younger members of N.A.G.T.

Its functions shall be to propose restrictions (if necessary) on membership; to suggest ways and means of encouraging all teachers to become affiliated with N.A.G.T.; and to state policies regarding eligibility.

## Article VII—DUES

The Association shall be empowered to collect dues from all but Honorary members of the Association.

The exact amount of such dues shall be established at the Annual Meeting and shall be collected through the organized Sections where possible.

## Article VIII—MEETINGS

There shall be one meeting of the Association membership or of the Executive Committee, or of both, each year, to be designated as the *Annual Meeting.*

Current business of the Association, matters of Association policy, reports of the Executive Committee and of other Committees, and the announcement of the mail ballot count on the election of officers shall be included in the agenda of the Annual Meeting. Meetings of one or more organized *Sections* may be held concurrently with the Annual Meeting of the Association, provided the Executive Committee of the Association has approved such combined undertaking.

## Article IX—PUBLICATIONS

The *Journal of Geologic Education* and the *Transactions* of N.A.G.T. are official publications of the Association. The Association may sponsor other formal and informal publications in the field of the teaching of the earth sciences as circumstances and resources may justify or permit.

## Article X—AMENDMENTS

Amendments of this Constitution may be proposed in writing, signed by at least 10 members in good standing of the Association, to the Executive Committee, or may be initiated by ⅔ vote of the Executive Committee. In either case the Executive Committee shall submit such proposed amendments to the members in writing together with a mail ballot which must indicate the closing date for voting. The results of the vote shall be tabulated and announced not less than one month and not more than three months following the date of distribution of the mail ballots. A majority of those voting shall be necessary to pass an amendment, provided that such majority constitutes at least ⅓ of the entire membership of the Association.

## Article XI—ENABLING CLAUSE

The Constitution of the National Association of Geology Teachers adopted by the members present at the Annual Meeting at Detroit, on November 10, 1951, shall be declared in force upon approval of the Association membership in the manner provided for adoption of amendments (Article X).

THE NATIONAL ASSOCIATION OF GEOLOGY TEACHERS was founded in the Middle West in May, 1938. In November, 1951, it was organized as a national association, under which there are at present seven organized regional sections: Central, East Central, Eastern, New England, Far Western, Southeastern, and Pacific Northwest. An annual meeting of the national association is normally held in the fall, and sectional meetings are held in the spring.

The purpose of the Association, as stated in its Constitution, is "to foster improvement in the teaching of the earth sciences at all levels of formal and informal instruction, to emphasize the cultural significance of the earth sciences, and to disseminate knowledge in this field to the general public."

Anyone concerned with geological education, formal or informal and at any age levels, is invited to apply for membership. *Inquiries should be addressed to the national secretary,* FREEMAN FOOTE, Williams College, Williamstown, Massachusetts.

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Vice President: ROBERT L. NICHOLS, *Tufts College*
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